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The Ideal Steam Plant.

There have been so many improvements and innovations in large and small apparatus entering into steam plants during the last few years that the difference in opinion concerning what is an ideal steam plant is growing wider than it was only five years ago. It is, of course, inevitable that some men will rank certain features of a plant as of greater importance than others. For example, those who consider the appearance of an engine room of importance will look with favor on the expensive tile floor and walls of the sewage pumping station illustrated on page 717 of this issue, while there are others who will consider the money paid out for this purpose an unnecessary expenditure. Some look wholly at utility. Some weigh the real advantages and disadvantages and estimate the money worth of a plant viewed as an investment, and set up a standard accordingly. The ideal plant in one place will, of course, be far from appropriate in different surroundings, and a standard for one class of service may be unfit for consideration in another class of work. The true ideal, from a strictly engineering point of view, is the attainment of the end in view with the least amount of running expenses and fixed charges. If the design of a steam plant and its later improvements were always made in accordance with an ideal such as this, the results would be highly satisfactory, whereas, in many cases they are quite the reverse. The familiar enquiry, "does it pay?" is the test that must be applied to a steam plant; if the answer to that question is in the affirmative, the plant is an ideal one for the real purpose of its design.

There are other things than fuel economy to be considered in deciding whether a novelty or a new design is worth its cost. It matters little how much economy of fuel a device will secure if it is wanting in durability, for the annoyance caused by continual repair and disorder is sure to end in throwing the device out of use, and then there is realization of the fact that the money invested in it was practically thrown away. Closely allied to the subject of durability is that of maintenance. A device may have the requisite durability provided the person who has the care of it makes special efforts to watch it and keep it in order; but if not guarded by this vigilance it will soon deteriorate and become disabled. If durability is attained by what may be termed continual maintenance, it is not the kind of durability which is desired in an ideal steam plant. No real durability exists unless it can be obtained by the application of an ordinary amount of care, such as common workmen can be depended upon to furnish. If a plant, or any part of it, is not absolutely durable, there is a feeling of insecurity about it which offsets the combined advantages in every other line.

The subject of durability is one which ought to be considered in connection with almost every feature in the design of a plant. Take the matter of engine speed. Starting with a type of engine which possesses ample strength, the size of it is dependent to some extent upon the speed, and looking at the subject from the single point of view of cost, the higher the speed the better. But there is a limit beyond which it is impossible to go, and a lower limit where the line ought to be drawn if due regard is paid to the ideal conditions of durability. Again, in the matter of working steam pressure, the same considerations should be given weight. Experience shows that extreme pressures are carried at a sacrifice of durability. All parts of the plant, starting with the boiler and following the piping to the engine, deteriorate at a much more rapid pace under high pressures, notwithstanding the fact that they may be designed for such extreme service. Whether this is also true of highly superheated steam is still to be definitely proved. The ideal plant must be constructed with these limitations in view. Again, the matter of durability is an important consideration with reference to that large class of auxiliary apparatus and appliances which make up the complete outfit. Some of these are necessary to the convenient operation of the plant, while others must be regarded more in the nature of refinements than as necessities. Whatever they are, it is important that they should be durable and reliable, and not dependent for their working upon extremely careful attention. Unless these appliances are absolutely reliable in ordinary hands, they will soon drop out of use.

Engineering Judgment.

So much is said about the cash value of judgment in civil engineering design and construction that some people, young graduates, members of Congress and others accustomed to form opinions quickly and positively, have grown to regard the expression as a mere flower of speech. The brilliant splendor of a complicated mathematical equation is a far more convincing proof of engineering ability, to the uninformed critic, than a knowledge of the amount of trench that a gang of laborers can dig in a day. It is doubtless satisfactory to figure down the amount of steel in a bridge design to the minimum consistent with strength and rigidity, but in view of the fact that shop requirements will probably make considerable change in the details of the design, there is manifestly a dividing line between features which it pays a designer to work up and those that are best left to the draftsmen of the bridge shop. The science of thermodynamics is a profound branch of physics, and a thorough master of it deserves to be called learned, yet it is safe to say that he would not be able to design a line of high-pressure steam piping without calling on somebody for practical information. Captain Eads was once asked why he was so positive that the assertions of several eminent scientists concerning the condition of a river bed were erroneous, since these specialists were willing to stake their reputations on the truth of their claims. He answered that he could not understand the theories and did not have the time to hunt for their mistakes, but was sure about the river bed because he had examined a considerable part of it in a diving bell. Such, at least, is the story that is told of him, and it is worth mentioning here because it shows the great difference between science and judgment in matters of civil engineering.

Fifteen years ago there was a tendency to belittle technical information gained in schools. It was claimed that too much science was being taught, and that the young men taking these courses were being filled up with a lot of miscellaneous information which was labeled applied science, but was really tommy rot. That period of distress is fortunately now past. Thanks to the great improvement that has taken place in technical instruction, the young man who gets through such a school without having a pretty good idea of the basic principles on which engineering rests is slick enough to be good timber for an old-style insurance president. Unfortunately, it is not at all improbable that the pendulum has been swinging too far in the other direction lately, and that brash youth laden with good theory but somewhat shy of experience is confident that he can design and construct anything desired. It is hardly possible to explain some of the strange things done in the name of reinforced concrete and the crimes perpetrated under the name of sewage disposal except on the supposition that there has been some youthful slip in making the theory fit the problem.

Just because an elderly chief engineer may not be able to solve a differential equation or to carry through a water analysis it does not follow that he is unable to appreciate their importance just as well as if he did the work. Probably he is considerably better informed as to their value in a general engineering scheme than the men who carry on such work, just because he can see their place in the whole broad undertaking he is directing. An engineering work requires a great deal more than mere technical knowledge. It requires the ability to size up a problem, to pick out the best available men for handling each feature of it, to keep these men working on the things they can do best, to join the work of each specialist into a co-ordinated whole, and then to see that it is executed properly by the contractors. All these things demand engineering judgment, and that is an attainment which cannot be taught in schools. Some people have it naturally developed at an early age, while others acquire it only through long experience. It is just as important as technical knowledge, and it is desirable that its value should be emphasized because most of the literature of engineering necessarily refers to technical matters.

The Stiffening Trusses of Long-Span Suspension Bridges.

It is generally considered by civil engineers that the economic length of ordinary railway truss bridges has been approximately reached. It may be 600 ft. or 700 ft., or possibly more, depending mainly on local conditions, but a point is found somewhere in that vicinity beyond which it will generally be found advisable to adopt some other type of bridge than the ordinary truss. This does not mean that the truss feature is to be abandoned, but rather that it is to find new adaptations in the requirements peculiar to long spans. These adaptations will be shaped to some extent by the character of material which it is feasible to employ and by the manner in which it is to be used. They may take the shape of more or less continuity, as in the cantilever type, or again as trusses employed in connection with cables as stiffening trusses. Bridge construction has already reached the stage in which the cantilever has found its place as intermediate in span between the upper limit of the ordinary truss and the lower limit of the stiffened suspension type, and continuity is one of its main features. Although the point of contraflexure is fixed in position and cannot move under any condition of loading whatever, the structure is truly a continuous truss. Indeed, from some points of view the cantilever and anchor arms are not so dissimilar to the stiffened suspension system, for the upper or tension chords perform the same functions as the cables, while the web members and the lower or suspension chords may be considered as similar in character to the same set of members in the stiffening truss. The compression chords of the cantilever and anchor arms carry largely the stresses which are eliminated in the stiffened suspension bridge by the resistance of the anchorages.

These general considerations really contain the essence of the reasons which make the cantilever system intermediate in position as to suitability and economy between the ordinary truss and the long-span stiffened suspension bridge. In a measure the low-stress tension material in the upper chords of the cantilever, combined with the compression material in the lower chords and a portion of the web member material, are, in cost, set against the high-tension material of the cables and the anchorage in the other type. This statement is obviously not exact to a nicety, yet it may be used as crudely correct. Just where the limit of maximum length of cantilever span is to be found has not yet been precisely determined, but cantilever designs for long spans like that for the St. Lawrence bridge near Quebec have shown that it will not usually be less than about 1,800 ft., and it may be materially more unless the site possesses characteristics peculiarly favorable to the stiffened suspension bridge. This advanced development of cantilever construction has brought civil engineers fairly face to face with the problem of the best design of the stiffened suspension bridge, meaning largely the design of the best form of stiffening truss, which is far from being a subject of simplicity.

The proper treatment of this rather complicated problem of design has attracted the attention of a considerable number of engineers both in Europe and in this country, and much divergence of opinion has been expressed concerning it. These divergent conclusions are quite natural. The stiffened structure is, in reality, a combination of two thoroughly dissimilar structures; that is, the truss and the cable. Their concurrent action raises at the very outset of any correct analytic treatment, questions pertaining to the elastic deformations of the two types of structure and of the members which connect them. In other words, the analytic treatment carries the engineer into various applications of the theory of elasticity in solid bodies, one of the most difficult fields of engineering science; yet it cannot be avoided. The old theory of the stiffening truss based upon certain arbitrary assumptions in which the elastic properties of the materials involved were ignored, was a loose approximation of great merit, but it no longer meets the requirements of advanced engineering design. In general it is absolutely necessary to base practical theory on a harmonious and reasonable recognition of the elastic strains or deformation of the constituent members of the combination constituting the complete stiffened suspension bridge. This is the more necessary for the reason that the stretching of the cables under loading and their contraction under falling temperature produce deflections in both directions so great as to induce stresses of considerable magnitude in the stiffening truss. In some cases these deflection stresses may be of high intensity. Again, if the stiffening truss is continuous from one tower to another it will inevitably carry a proportion of the moving load which may be relatively high if the truss is comparatively deep. The function of the stiffening truss is the distribution of any partial or irregular load so as to produce a uniform pull on the cables, but in consequence of the high intensity of stress allowed in the metal of the cables it is manifestly economical to make them carry the highest possible proportion of the total moving load, the whole of the dead load always being supported by them. The shallower the stiffening trusses are made the less will they carry as simple trusses; that is, independently of the cables. On the other hand, a shallow truss means one of comparatively great deflection for a given loading, and this means a correspondingly great distortion of the cable. A deep stiffening truss will permit less distortion of the cable, but it has diminished economy in consequence of carrying a higher percentage of the moving load as a simple truss. A proper balance must be made between these opposing considerations, and it will be affected materially by such truss features as joints at the ends and center of the span.

Flue Gas Analysis on a Water-Tube Boiler.

The subject of flue gas analysis has attracted considerable attention of late, and attention may therefore be called to the results of a series of tests which were reported in this journal some years ago. They were made to show the character of the gas in a hand-fired water-tube boiler with plain furnace and ordinary setting under certain conditions of running, the test being made with an Orsat apparatus. The boiler was one having the ordinary vertical flame plates, and three vertical passes for the gases, being of the 250 h.-p. size. The width of the space between the two side walls was 8 ft. 6 in. The sampling pipe was introduced between the third and fourth row of tubes, counting from the top in the rear pass, a hole being driled through the side cleaning door for the purpose. The pipe was of the ⅜-in. size, 4 ft. in length, and it was perforated with seventy-two 1/16-in. holes, arranged in three rows, twenty-four in each row. This was laid on the tubes beginning at a distance 12 in. from the inside face of the outer wall, and connection with the gas apparatus was made through a ¼-in. pipe. In this position the sampling tube drew from only one-half of the entire space, but this seems to be a proper arrangement considering that the boiler had two fire doors, and a sample obtained from one-half of the entire width of the space should give a fair indication of the whole. The damper was set at a fixed point so as to give a draft of about ¼ in. water pressure, and the rate of capacity developed by the boiler was maintained constant so far as this was controlled by the draft. The coal used was a grade of New River semi-bituminous and the thickness of the bed of coal on the grate at times just before firing was from 8 to 10 in. The samples were drawn for periods of one minute, and they were taken twice during the period while one firing was being burned out; the first sample being taken two minutes after firing, and the second some twenty minutes, the fire in the meantime having been loosened with a slice bar and sometimes leveled off. The firings occurred at intervals of about thirty minutes.

The interest in these analyses lies in the effect which is produced by the different conditions of the fire. On the first test, which was made one minute after firing 20 shovels of coal, the carbon dioxide was 12.4 per cent., the oxygen 4.4 per cent., and the carbonic oxide 1.1 per cent. After an expiration of 28 minutes, during which time the fire had been barred up, the second test was made and showed that the carbon dioxide had fallen to 10.7 per cent., the oxygen had increased to 9.3 per cent., and the carbonic oxide had fallen off to 1/10 of one per cent., thus showing an increase in the amount of surplus air, and a marked improvement in the combustion due to the reduced quantity of volatile gases as the fire becomes burned down. The third test was made two minutes after firing 32 shovels of coal, and it showed for carbon dioxide 14 per cent., oxygen 2.1 per cent. and carbonic oxide 2 per cent. The new coal added on this firing was an excessive quantity, and this was revealed at once by an increased amount of carbon dioxide and a reduced percentage of oxygen in the gases. The next test was made 24 minutes later, the sample being drawn one minute after the fire was leveled off. The effect of this operation is to fill any holes or low spots in the bed of coal and make it a more solid mass. This test showed 16.9 per cent. carbon dioxide, 1.2 per cent. of oxygen and 1.3 per cent. carbonic oxide. The increased solidity of this mass of coal is shown in the small quantity of oxygen, and again in the continued presence of carbon dioxide, although somewhat reduced. On the fifth test a sample was drawn two minutes after firing 20 shovels of coal, and we have almost a duplicate of the previous test, the result being carbon dioxide 13.7 per cent., oxygen 2.2 per cent., and carbonic oxide 2.5 per cent. At the expiration of 21 minutes from this time the sixth drawing was made and this occurred five minutes after barring up the bed of coal without leveling it off. The result of the analysis, then, is very different from the corresponding time on the previous test, the carbonic oxide disappearing altogether, the carbon dioxide being 13 per cent. and the oxygen 6.4 per cent. The effect of the more open condition of the coal bed in allowing a greater supply of air to pass through, and, consequently, to increase the oxygen in the gas, is plainly revealed. The seventh test was made two minutes after firing 20 shovels full of coal, and showed carbon dioxide 14 per cent., oxygen 2.7 per cent. and carbonic oxide 1.7 per cent. At the expiration of 15 minutes the eighth sample was drawn, this being done six minutes after the fire was opened with the slice bar, but not leveled off. The quantities then changed, the carbonic oxide disappearing altogether, the carbonic dioxide falling to 11.6 per cent. and the oxygen rising to 8 per cent.

These analyses furnish still further proof, if such were needed, that it is objectionable to carry heavy fires and to fire large quantities at a time. In one of these tests the carbonic oxide amounted to 2.5 per cent., and this loss of unconsumed carbon represents for the time being about 1,500 B.t.u. for every pound of coal consumed. If this boiler worked with an efficiency of 70 per cent., on coal having a calorific value of 13,500 B.t.u. per pound, the loss from this cause represents about one-sixth of the heat utilized. The effect of a thick bed of coal, on the other hand, is in one sense advantageous, for, as will be seen from these examples, it reduces the quantity of free oxygen in the gases, which is an indication that the corresponding supply of air is likewise reduced. In one case the oxygen drops down to 1.2 per cent. and in another to 1.7 per cent. This reduction is accompanied, however, by a considerable quantity of unconsumed carbon, so that in cases of hand firing it results in no benefit.

Electrification on the Pennsylvania Railroad.

The announcement in last week's issue that the Pennsylvania Railroad Co. had placed contracts for the electrification of a line between Camden and Atlantic City, N. J., has naturally attracted a large amount of attention. In this district are some of the most famous pieces of track in the country, and the train speeds regularly attained on them are very high. The Pennsylvania line is probably well known to most railway officials of other countries who have visited the United States because it is one of those roads which are considered typical of one class of American service. Consequently the decision to operate electrically a Camden-Atlantic City service is as important in its way as the decision to use electricity at the New York terminals of a number of trunk lines.

The contract is for the electrification of 64 miles of line now operated by steam locomotives. It is proposed to utilize the Cape May line of the West Jersey and Seashore branch of the Pennsylvania system from Camden as far as Newfield, double-tracking it with 100-lb. rails, and to build an additional track from Newfield to Atlantic City, making a double-track line suited for the highest class of express service for the whole distance. The initial installation will provide for a three-car train every 15 minutes between the two terminals and the run of 64 miles is scheduled for 80 minutes, without stops. The maximum speed of the cars will be between 55 and 60 miles per hour. In addition to this through service a half-hourly schedule is planned, consisting of two-car trains between Camden and Millville, 40 miles, and a ten-minute service of single cars between Camden and Woodbury, 8½ miles.

The most interesting feature of the contract at the present time is that it calls for the same type of direct-current motors that will be used on the cars of the New York Central & Hudson River R. R. for its suburban service at New York. The contract pretty effectually does away with the assertion that the New York Central equipment would be the last direct-current installation for steam railway lines. The Pennsylvania R. R. will use 58 cars, each furnished with two 200 h.-p. General Electric motors, controlled by the Sprague-General Electric automatic multiple-unit system, permitting the operation of cars in trains with all the motors under the control of the motorman in the cab of the forward car.

Power will be furnished from a station at Camden, where there will be three 2,000-kw. Curtis turbines supplying three-phase alternating current with a frequency of 25 cycles. The transmission lines will run to six sub-stations between Camden and Atlantic City, and a seventh sub-station at Millville to supply the section of the road lying between that place and Newfield. The transmitting potential will be 33,000 volts. At the sub-stations a total capacity of 11,000 kw. in rotary converters will be provided, delivering direct current to the third rail at 650 volts. The third rail will be used on all but two sections, where the overhead trolley will be employed and a lower speed maintained. These low-speed sections are between Camden and Woodbury and between Newfield and Millville.

The contract calls for the completion of the road by July 1 of next year, and involves about $3,000,000. If the General Electric Co. lives up to its time guarantees, which is to be expected, a large number of the readers of this journal will doubtless have an opportunity of inspecting this interesting line during their vacation trips to the New Jersey watering place. The service which the electric trains will render will be watched with much interest, for it will be the nearest approach to main line operation by electricity that has yet been attempted in this country.

Notes and Comments.

WATER GAUGES on drip pockets are valuable in high-pressure steam piping in order to indicate whether the trap is draining regularly or not. For this purpose automatic or chain-closing gauges should be used, as this would enable them to be closed from a distance if the glass should break.

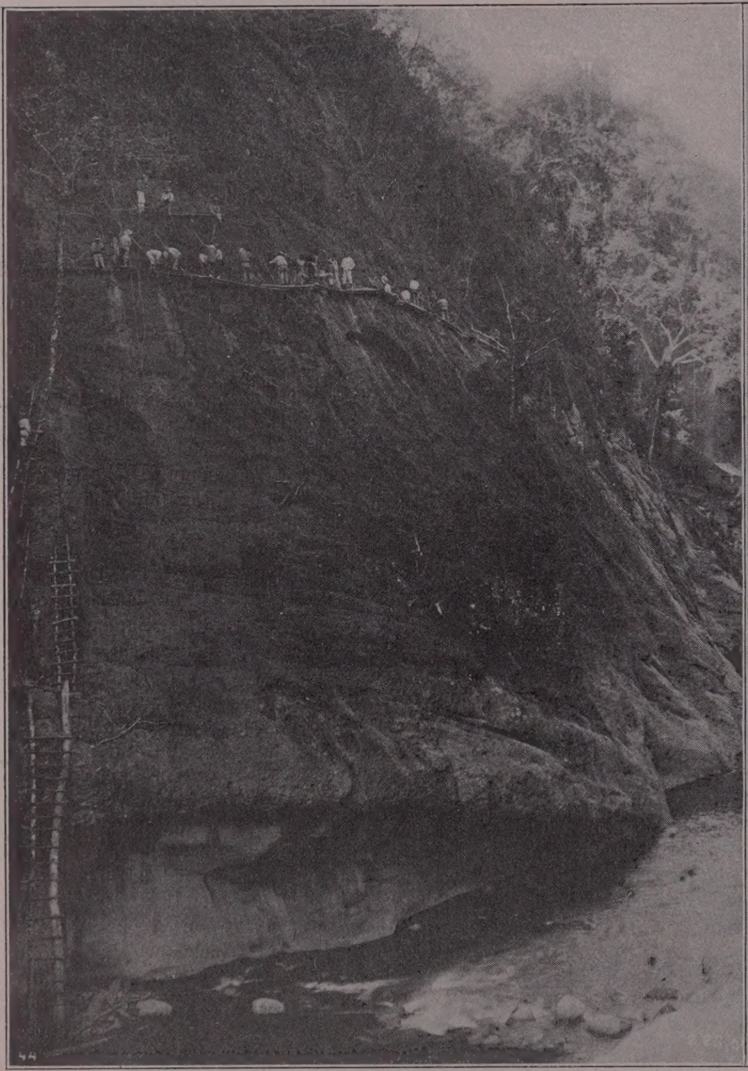
AN UNUSUAL ACCIDENT OCCURRED recently at the 14th St., Hoboken, power plant of the Public Service Corporation of New Jersey, where a 23-in. shaft of a direct-connected generating unit broke. The unit consisted of a 1,000-h.-p. horizontal cross-compound Providence-Corliss engine driving a 750-kw. alternating-current dynamo for a commercial lighting and power load. The unit was carrying a steady load of about 850 kw. when the shaft broke without warning, allowing the rotating field to drop, but without seriously damaging the engine or generator. There is slight evidence of a flaw in the shaft.

AN EXHAUST STEAM TURBINE was put in service on Dec. 15 at one of the stations of the Philadelphia Rapid Transit Co., which will probably yield valuable engineering data. The station contains four 1,500-h.-p. Wetherill-Corliss engines and one of 2,200 h. p., which have always been run non-condensing owing to the scarcity of cooling water. In order to increase the economy of the station an 800-kw. Curtis turbine has been installed together with an Alberger cooling tower. The turbine, which takes steam from the exhaust main of the reciprocating engines at a very slight, if any, excess over atmospheric pressure, drives a direct-current generator at 1,100 to 1,200 r.p.m. The rotary pumps for the cooling water of the tower are driven by an inter-pole motor of 120 h.-p. rating. The smaller reciprocating units furnish an average current of 2,000 amperes at 575 volts. The turbine furnishes a current of 1,300 amperes, but about 150 amperes are required to operate the auxiliaries, leaving 1,150 amperes as the net gain due to the turbine plant. This is equivalent to an increase of 57½ per cent. over the output of the reciprocating unit, over twice the gain that could be obtained by installing a condensing plant alone. The turbine runs on a vacuum averaging 28 in. The plant has been in operation such a short time that the above results must be regarded as provisional.

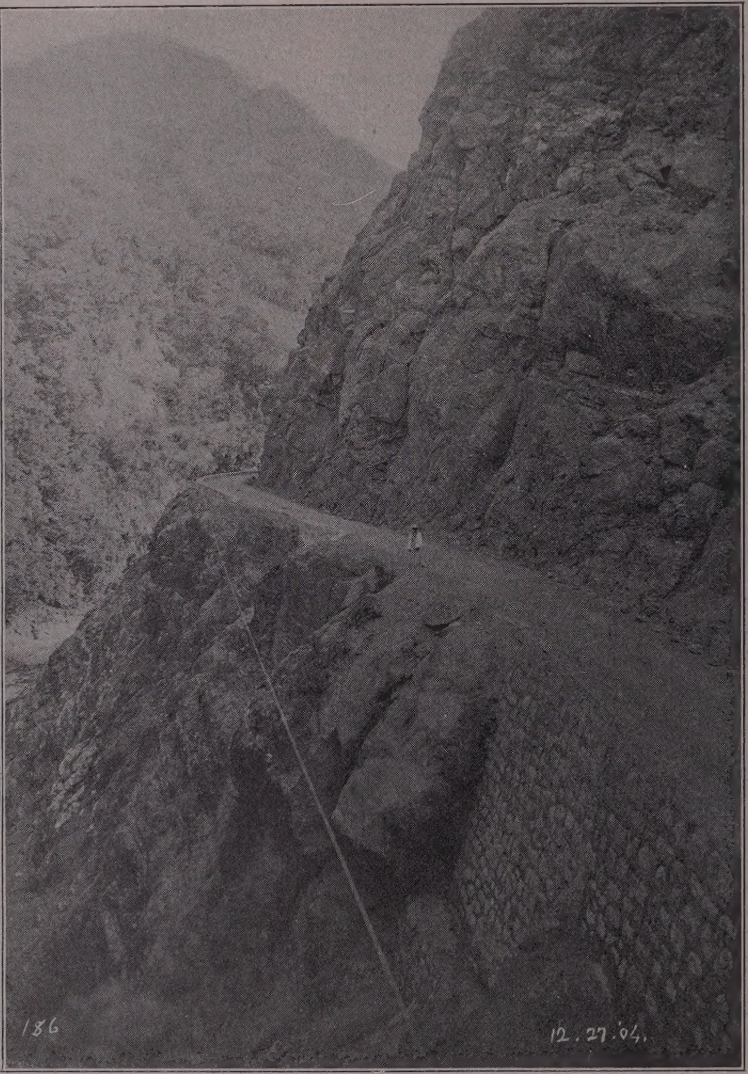
THE STRIKE against the erection department of the American Bridge Co. has attained such a stage as to deserve serious consideration. The men went out without any real grievance, abandoning many thousands of tons of work because the company sublet the erection of a portion of the work to a firm employing non-union men. The employees of the American Bridge Co. were receiving union wages, about double those received by the same class of men a very few years ago for less hours, and do not even pretend to have any dissatisfaction with their treatment. Nevertheless in New England, where the company has been trying to start about 20,000 tons of heavy work for the New York, New Haven & Hartford R. R., with non-union men, they have encountered such opposition that work is being carried on at tens of thousands of dollars' additional expense, under the protection of numerous armed guards. In one place during a heavy Sunday rain storm a man eluded the guards and put dynamite under a hoisting engine boiler. Fortunately the fire was so well banked that the bundle containing the explosive did not ignite before the fireman discovered and withdrew it. Within a few days of this occurrence twenty-six dynamite cartridges, with fuses, complete, were arranged on an erection traveler on one of the bridges, but these also were discovered and removed before work was commenced. In both these cases the destruction of property, or the delay of the work alone, was not contemplated, but a deliberate effort was made to take a large number of lives, which would certainly have been sacrificed but for unusual vigilance.

THE GRADE READJUSTMENT of the Delaware, Lackawanna & Western R. R. in Harrison and Newark, N. J., was completed last Sunday by the lowering of the tracks into a deep cut cross the Morris and Essex canal. The entire improvement is now finished except for the cleaning up of the portion of the line which has just been lowered. Since the undertaking was begun, 1.6 miles of track have been raised and 1.8 miles have been lowered. The heavy nature of the work has been fully explained in numerous articles in this journal, which have also described the manner in which the construction was carried on. The problems involved in lowering the tracks were particularly difficult, not only on account of the narrow right-of-way in which they had to be carried on, but also owing to the numerous trains which had to be cared for. The railroad has an enormous suburban traffic. During the rush hours of the morning and evening, trains succeed each other on a very short headway, so that a slight interruption will derange the service of a great many trains. The manner in which this difficult construction has been carried out reflects great credit on Mr. Lincoln Bush, chief engineer of the company, and his assistants, and the care shown by the contractors deserves praise. There has been no serious accident and no material interruption of service since the improvements began, although the conditions have been such at times that only the best of design for the temporary works and the most careful attention to all details by the resident engineers and contractors enabled the train service to be maintained satisfactorily. The successful completion of this difficult undertaking adds materially to the hearty approval with which the suburban population on the Lackawanna road looks upon the improvements of its lines. These are now in progress in several other places, and their completion will be succeeded by the installation of an electric system of operation as soon as this can be done safely.

CONSTRUCTION OF THE BENGUET ROAD, LUZON, PHILIPPINE ISLANDS.



Cutting a Slope in an Abrupt Side Hill.



A Typical Piece of Finished Road in Rough Country.

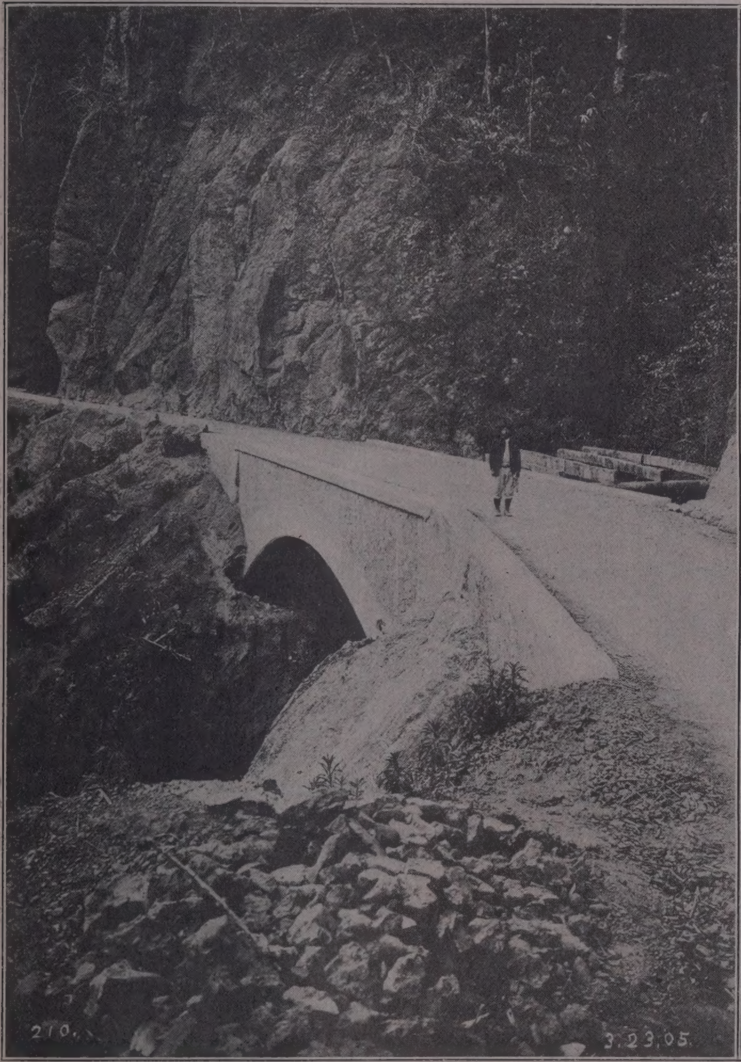
One of the most notable pieces of engineering construction that has been carried on in the Philippine Islands since the occupation of the latter by the United States government is the highway leading from Dagupan, on Lingayen Gulf, in Benguet Province, to Baguio, 30.77 miles inland. The headquarters of the civil government of the Philippines is established in Baguio during the hot season to escape the intolerable heat along the coast. Baguio is about 150 miles north of Manila, and being 5,000 ft. above the sea, has a moderately temperate climate. Dagupan is connected by railroad with Manila, but prior to the construction of the highway the route to Baguio from Manila was by sea to San Fernando, a distance of 240 miles, then up trails leading up the valley of the Naguilian River and small streams tributary to it for 45 miles. The railroad could be taken to Dagupan and a very bad coast road followed from there to Baoang and Naguilian, a slow and difficult journey of 200 miles on horseback, requiring 3 days. The whole journey can now be performed, since the completion of the new highway, in 15.5 hr., including 8.5 hr. required to make the 122-mile railroad trip from Manila to Dagupan.

The new road has a total length of 45 miles and ascends 4,900 ft. in that distance. The country in the first 12 miles traversed by the road is not particularly rough and did not require much unusual construction, the total rise in this part of the work being less than 900 ft. The country through which the remainder of the road passes is exceedingly rough and the road building was prosecuted with exceptional difficulties. Not only were unusual difficulties presented by the physical characteristics of the country, for the lack of means of transportation of materials and supplies, the inability to obtain skilled, or even intelligent labor, and the severe climatic conditions existing during at least half of the year made it specially hard to secure the rapid progress followed in the construction.

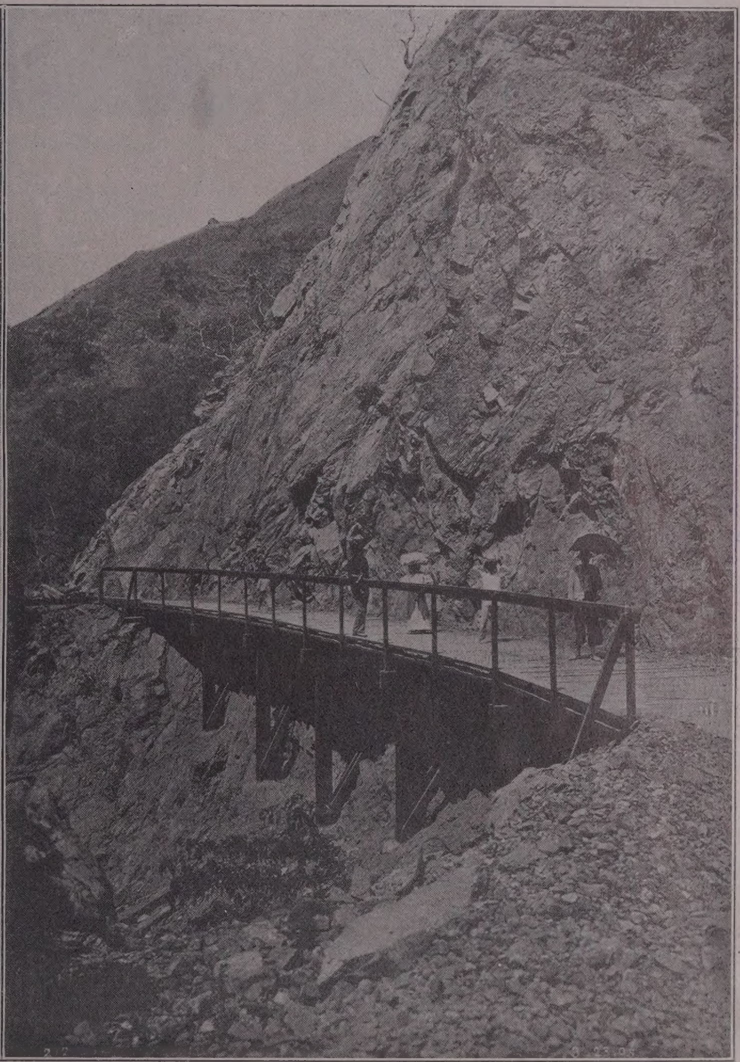
The valleys of the streams followed by the highway are very precipitous, rising in much of the rough country on a slope of 1 to 1 for several hundred feet above the water. These steep side hills are largely dense shale which is covered with thick growths of heavy timber. Some of them are solid rock ledges rising directly from the water, with practically no manner of approach except from the top. The native trails followed up these valleys, crossing the streams on logs which were washed away by every storm. The trails crossed over the mountains by circuitous routes whenever a specially abrupt cliff was encountered, some of the peaks crossed in this manner being over 1,200 ft. high. The materials and supplies for the early part of the work had to be carried over these trails in packs by the Igorrote natives, who were also largely employed on the construction work. The average annual rainfall is more than 100 in., which falls during 6 months of the year. A fall of 6 in. of rain in 24 hours is not unusual, and the character of the country through which the road passes makes the run-off very heavy. A fall of 10 in. or more in 24 hours will, however, produce a flood, but during the construction this amount was exceeded many times, and on several occasions 18 in. of water fell in 24 hours.

The road has a uniform width of 14 ft. and is practically all built on benches cut in the side hill. It has been built with the idea of eventually laying an electric trolley line over it, and its maximum curvature has a radius of 100 ft. Although it makes practically all of an ascent of 4,000 ft. in less than 20 miles the maximum gradient is 9 per cent., this percentage of grade occurring in exceptional places only, and being maintained for but short distances. The surface of the road in the rough country is not crowned, but slopes toward a paved gutter along the inner edge. The gutter carries the storm water to culverts built through the road, generally at intervals of about 600 ft., although frequently at less intervals. This type of construction was followed chiefly to avoid a gutter along the outer edge. The bench on which the road is built is supported along the outer edge in many places by high dry-rubble and rubble-masonry walls. The excessive amount of run-off has to be carried along the roads to culverts at the ends of these walls to eliminate any possibility of the latter being undermined. A road sloped each way from the center would have required a gutter on both sides, increasing the width of the bench to that extent and in many places increasing the cost of construction out of all proportion to whatever advantage, if any, that a crowned surface may have over a surface all sloped one way.

Only enough of a bench was cut into the sidehills to carry the roadway, but in many places this required tremendous quantities of materials to be moved. The wooded hillsides had to be cleared first. Then they were cut back until they were on slopes of 1 to 1, or until practically all danger of slides on them was avoided. The shale formation in many places scaled badly and had to be cut back excessively to secure slopes which would stand under the heavy rainfall. In several places these slopes reached over 300 ft. above the roadway and at one point the slope was carried 800 ft. above the grade of the road. Some of the rocky cliffs carried boulders so that they also had to be cut back until there was little chance of the boulders or loose rock falling on the road. Men were let down the cliffs with ropes and after they had cut holes for iron pegs, boards were placed on the latter, forming scaffolds on which they could work until a bench wide enough to stand on could be made. Various types of American made rock drills were employed in making holes for blasts. Some of the material was handled in wheelbarrows where small fills had to be made. A narrow-gauge track, with wooden rails, was laid in one place and hand-made dump cars, with wooden wheels, were used in hauling dirt. In most places, however, the chief work was to cut out and blast back the face of the hills until they were firm enough to stand, the loosened materials falling into the valleys below.



Concrete Arch over a Deep Gulch.



A Bridge with Bents having Single Posts.

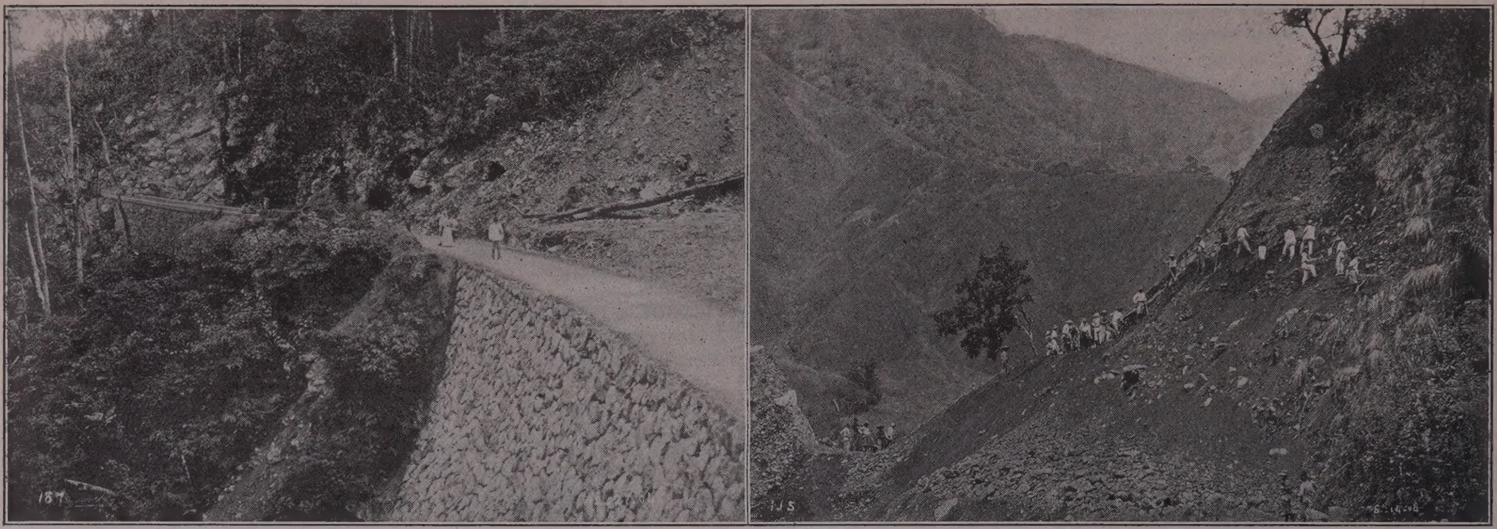
The hillsides in many places are furrowed with deep, narrow gulches whose bottoms are almost as steep as the hills themselves. These gulches carry much storm water, which has to be conveyed across the roadway wherever the latter crosses them. The roadway is generally carried across the narrowest gulches on fills held in place by retaining walls. In building one of these walls the site of its base would first be leveled off, and then a heavy reinforced-concrete beam, keyed in the rock, was built longitudinally along the foundation to provide a stable footing course. The wall was then built on this beam, and was made of dry rubble, or rubble masonry, depending on the character of the materials obtainable and the slope on which its face could be built. The dry-rubble walls are usually stepped toward the bottom to secure an additional factor of safety. The rubble masonry walls have a concrete coping in many places which is built up 12 in. above the roadway to protect the wall from wash.

The typical method of carrying the storm-water at these gulches is to continue the gutter on the inside of the road to a point below the wall, and connect it there with a concrete culvert built under the roadway, the point of discharge of the culvert being placed so there can be no possibility of the wall being undermined. If the gulch carries so much storm-water that this method cannot be followed, the stream is carried under the road through an arch.

The arches were mostly constructed with concrete voussoirs extending the full width of the arch. The spandrels and wing walls of smaller arches were built of coursed rubble masonry, laid with lime-mortar. Those of the larger arches were built of concrete. Green Island Portland cement, which is made in Hongkong, was used in part of the work and Atlas Portland cement in the remainder. The American cement cost $2.30 a barrel, laid down in Manila, but owing to the excessive freight rate from there and to the difficulty of transporting the cement from the end of the railroad to the work, it cost on the average $5.50 a barrel delivered. The sand and gravel, or broken stone were obtained locally, although in certain sections good sand was scarce. The lime was manufactured in a kiln built in connection with the work.

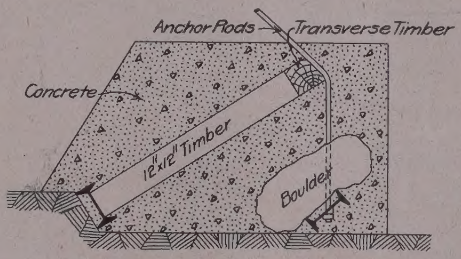
A large number of bridge structures were required to carry the highway over deeper gulches across which it was impracticable to make fills, owing to the heavy storm-water flow. Timber bridges have been built under these conditions and the intention is to eventually supplant them with steel structures.

The smaller gulches in which the flood flow is relatively light are crossed on pole-bent, or timber-bent trestles. The pole bents usually have a batter post on each side, with a central plumb post, and a pole cap. They are cross-braced and sway-braced. The timber bents have two plumb posts, one under each outside bridge stringer, and are X-braced. The posts of all bents are set on solid rock, or on masonry footings. The floors of all bridges and the timbers of those with


A High Retaining Wall, with Finished Roadway; Cutting Back the Roadway Slopes in Shale.

timber bents are built of Oregon pine. It was cheaper to buy the finished lumber in this country and ship it to the Philippines than to secure it locally, where the primitive methods of hand-sawing make the cost excessive, although good timber is abundant. Some of the trestles have a wooden-deck Pratt truss with iron-rod bottom chords and end ties, over the channels. The wooden members of these trusses are built in some cases of two or three 3x12-in. plank bolted together.

A few short bridges, with bents having only one post, the other end of the cap resting on the rock of the side hill, were built over breaks in the hillsides where retaining walls could not be erected readily. The post of each of these bents is plumb and is doweled to the rock at the bottom by an iron rod grouted in a hole in the rock. The top of the post is doweled to the cap and the other end of the cap is doweled to the rock by another iron rod grouted in the latter. This form of construction has been found very satisfactory and greatly facilitated the progress of the work in several cases.



Anchorage for Suspension Bridges.

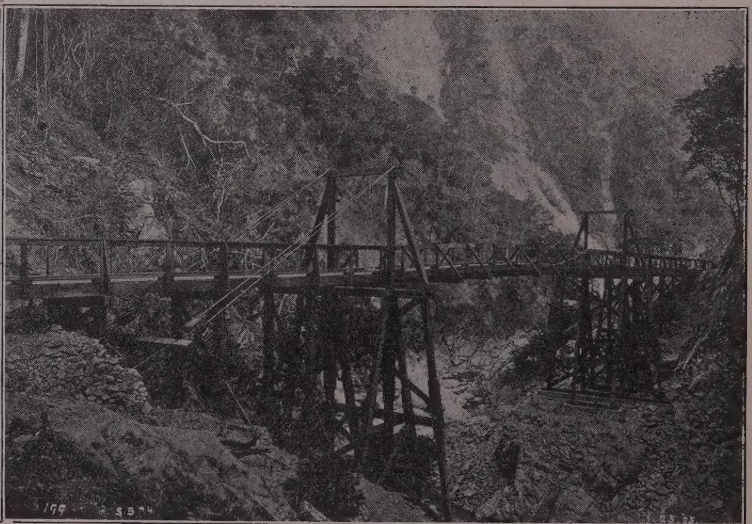
The main river, across which trestles could not be erected, is spanned at various places by suspension bridges. These bridges have timber towers and floor systems and are carried by steel-wire cables. They have spans varying from 130 to 186 ft. and have a uniform width of 10 ft. Some of them have a short length of timber trestle at each end and in those cases their towers are carried on timber frames built up of one vertical and two inclined bents; others have their towers resting directly on concrete abutments laid on the solid rock at each end of the bridge. The towers consist of a single vertical bent in each case and are designed to act as though hinged at the base. The floor rests on longitudinal joists which are carried by transverse beams on 5-ft. centers. Each transverse beam is supported at the ends by cable suspenders attached to the main cables. Each bridge has two main cables, one on each side. Each main cable has two strands made up of a continuous cable with a single splice. The cables pass around a hardwood block at each end, which has round corners and sufficient thickness to avoid breaking the wires. Iron rods pass through each block and are attached to the anchorage, provision being made for tightening and loosening the cables.

The anchorages are nearly all in solid rock. Six to eight 2-in. vertical holes were drilled in the rock in two transverse rows, then 1½-in. iron rods, with wedge-shaped lower ends, were driven into these holes and the space in the latter filled with grout. The upper ends of the rods were bent in line with the cables and passed through holes in a 12x12-in. timber to hold them in their proper positions. In some cases anchorages were built with transverse steel I-beams buried in concrete, as shown in the accompanying diagram. Each end of one of the beams was weighted with a boulder and the rods to which the cables are attached fastened to it. These rods are bent about 45 degrees from the vertical just below the top of the concrete and a transverse timber placed in the bend. This timber is braced against another transverse I-beam in the bottom of the concrete and at the front so as to lift the cables high enough to permit covered wagons to pass under them.

The construction of all these bridges had to be carried on with as much speed as possible. The bridges had to be made sufficiently strong to carry traffic until provisions can be made for more permanent structures. The lack of skilled labor required the use of the simplest possible methods, but all of the bridges have proved satisfactory under traffic.

The difficulty of obtaining good labor was one of the greatest obstacles encountered. A force of 4,000 to 5,000 men, made up of 46 nationalities, was employed much of the time. The common labor was largely done by about 2,500 natives. Large numbers of Japanese were also employed, and were found to make very efficient workmen. Much of the bridge building and the carpentry and masonry work on the arches and walls was performed by them. They were perfectly fearless and no difficulty was experienced in getting them to do any of the hazardous

A Piece of Retaining Wall.


A Supension Bridge.

sidehill clearing, nor the work connected with starting the benches in abrupt rock slopes.

The men were housed in several camps in which the most strict discipline was maintained in order to avoid epidemics. Each camp was under the immediate direction of an American foreman, who had complete jurisdiction over its affairs and the manner in which the men under him worked, he being responsible directly to the engineer in charge of the entire undertaking. He was provided with quarters separate from the camp, to give him proper distinction. The white laborers, usually called the Americans, although they came from all parts of the world, had quarters by themselves. The Japanese and natives also each had separate quarters. During the dry season tents were used to considerable extent but were replaced in the rainy season by thatched-roofed buildings, which answered the purpose well. Good water was usually obtainable and favorable sites for camps were abundant. Sickness was at no time prevalent enough to interfere with the prosecution of work and little trouble was experienced in maintaining proper discipline among the laborers after it was once established.

The road was located and constructed under the immediate supervision of Col. L. W. V. Kennon, 34th Volunteer Infantry, U. S. A., acting for the civil government of the Philippine Islands. Col. Kennon not only supervised the work, but also personally directed the construction and designed the structures connected with it, having in addition to these duties general supervision of the camps of the entire force of men employed.

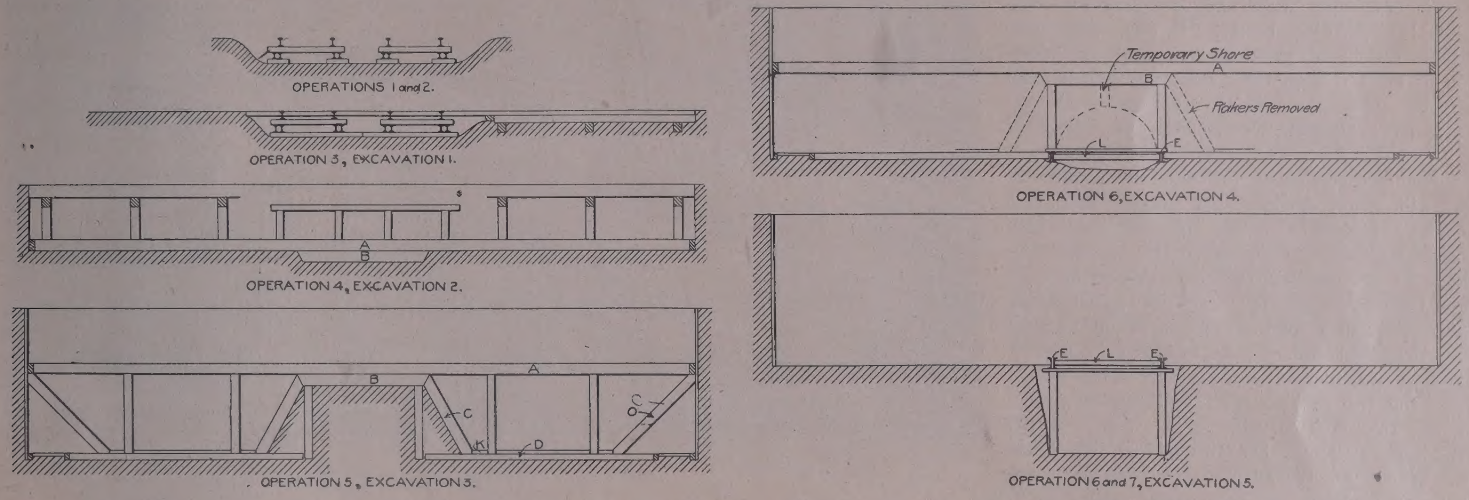
Rapid Transit Subway Construction on Fulton St., Brooklyn.—I.

That portion of the Brooklyn branch of the New York Rapid Transit R. R. System which is in the upper part of Fulton St. and Flatbush Ave. is a reinforced concrete subway which conforms in many respects to the Flatbush Ave. section described in The Engineering Record of October 22 and 29, 1904. Since the appearance of that article the popular agitation in favor of a four-track structure has resulted in a considerable modification of the original design and the changing of 2,600 lin. ft. of structure on Fulton St. from two to four tracks, involving a corresponding change in the quantities involved and methods of executing the contract. As now being completed the section 3 of contract No. 2, extends about 5,700 ft. from Clinton St. to Atlantic Ave., and includes about 1,000 lin. ft. of two-track line, the remainder being four, five and six-track work, with stations at Borough Hall, Hoyt St., Nevins St. and Atlantic Ave.

The changes in the plans necessarily delayed portions of the work until the new designs were finally adopted, after which the contractors proceeded as far in conformity with the four-track plans as was possible without exceeding their legal restrictions. The last of these were removed about the first of October, since when the work has been pushed as rapidly as possible. It was impossible to order the additional steel until a comparatively late date and the congested condition of the mills has considerably delayed its delivery, so that the progress of the work has but recently reached a normal state. It is estimated that on November 1 about one-fourth of the contract, as measured by estimates approved, had been completed.

The new four-track structure in Fulton St. corresponds with the description of Oct. 22, 1904, except as indicated by the accompanying cross section and explanatory notes. About 2,600 lin. ft. will be built, all in open cut. The methods are interesting on account of the systematic planning and arrangement of operations, the economical and efficient system of timbering, the rapid and careful excavation and especially for the novel manner of building the concrete roof in short full-width alternate sections with the minimum obstruction from, or shifting of, the temporary timbering. Where the two-track structure had been built before it was decided to make it four-track, the two additional tracks are to be added to the outsides of the original structure as shown in the accompanying cross section on Fulton St. near DeKalb Ave., and the subway is symmetrical about the center line except where, as is here shown, the elevated railroad columns are not on lines at right angles to the axis of the subway and provision is made on one side only, in the same panel, for their support. An open trench about 14 ft. wide will be excavated on each side of the subway and in it the new floor and roof for one track will be built and connected to the existing structure.

Care will be taken to bond the new concrete floor and roof to the old. The contact surfaces of the old walls will be cleaned and roughened and staggered holes drilled 6 in. in the base of the wall 12 in. apart and 1-in. horizontal dowels 12 in. long will be grouted in them to bond with the


OPERATIONS 1 and 2.
OPERATION 3, EXCAVATION 1.
OPERATION 4, EXCAVATION 2.
A
B
OPERATION 5, EXCAVATION 3.
A
B
C
C
D
K
Temporary Shore
A
B
Rakers Removed
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OPERATION 6, EXCAVATION 4.
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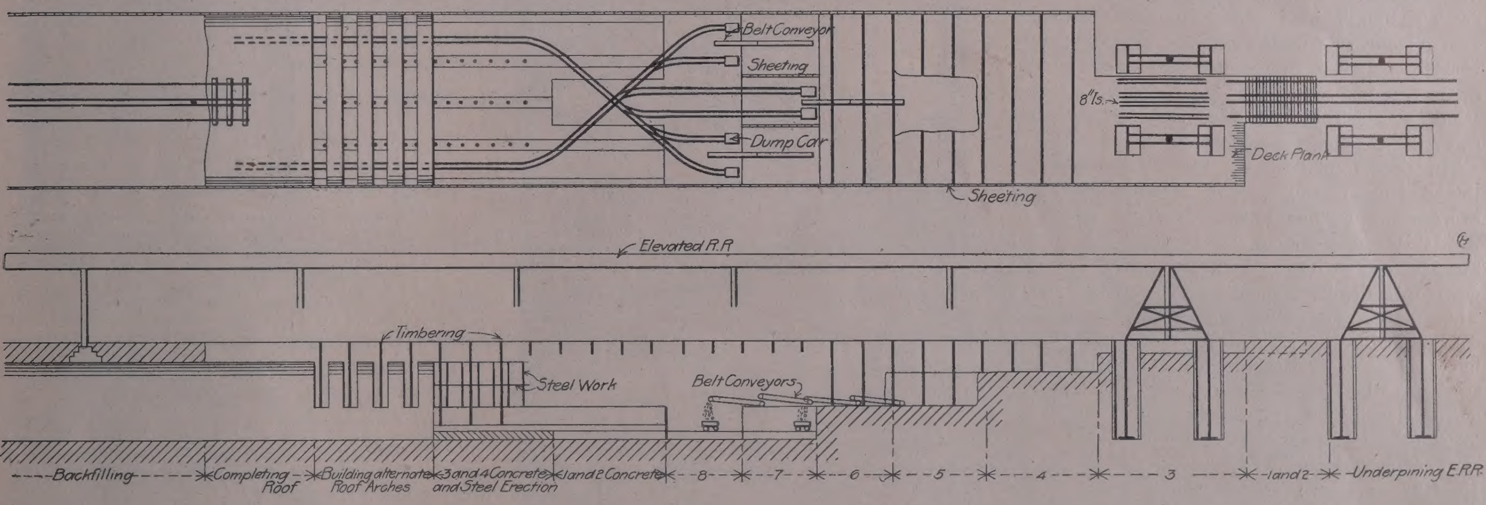
OPERATION 6 and 7, EXCAVATION 5.

Successive Excavating and Timbering Operations.



Sequence of Construction Operations.

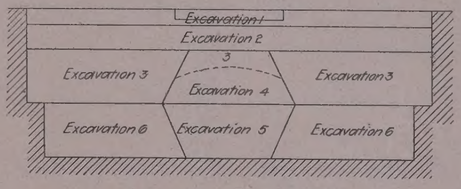
new concrete. The tops of the walls are to be notched out to provide seats for the new roof arches and a furring of expanded metal anchored to them with ¾-in. split bolts 18 in. apart. The new roof overlaps the old one about 3 ft. and is to be bonded to it by 1-in. horizontal reinforcement rods 6 ft. long and 12 in. apart which are bedded in it and have their ends bent at right angles to anchor into the old concrete.

The new walls and roof are reinforced with 1¼-in. vertical and horizontal rods spaced respectively 10 in. and 7½ in. apart and have no columns or girders except where the elevated railroad columns are supported on the subway roof. Here, as shown at the right of the cross section the column footings are to be received on a set of 10-in. longitudinal I-beams web-connected to 24-in. transverse I-beams 5 ft. apart. The latter are seated on 12-in. I-beam columns in the new outer walls and on a pair of longitudinal 8-in. grillage beams, 4 ft. long, which distribute their loads on them to a seat cut in the top of the old wall, the footing of the old wall directly undeneath being reinforced by an extension of the new floor concrete 2 ft. thick and 4 ft. wide. The section above described will be modified somewhat for different conditions, but will retain the principal features and have varying dimensions where the four-track subway is built as an extension of a two-track section. Where the two-track construction had not been built before the four-track was adopted, the four-track will be built at one operation as hereafter described, and is made with three longitudinal rows of columns like the center column shown here, the two outside rows replacing the walls of the two-track structure. The walls of the four-track structure are throughout like those here shown for the adapted structure, and contain refuge niches, not here shown, about 50 ft. apart. In one place the subway is designed for five tracks and is built to correspond with the cross section here shown except that the extension on one side of the old two-track structure is wide enough to provide for two tracks instead of one, and is spanned by plate girders about 3 ft. deep which have 6x6-in. flange angles and carry the elevated railroad columns.

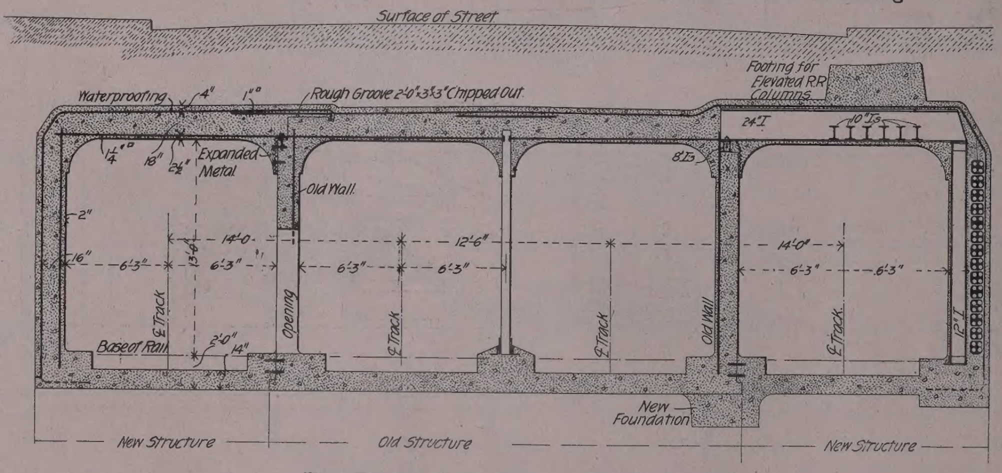
The open trench for the four-track section of this division is about 60 ft. in width, and has average and maximum depths of about 21 and 24 ft. It is excavated entirely by pick and shovel through clayey loam containing some boulders down to a depth of about 12 ft. below the curb, where a deep stratum of fine sharp dry sand is encountered. The clay and loam stands well unbraced at a steep angle for a long exposure to the weather, but the sand runs easily and requires sheeting as fast as excavated, and produces a heavy pressure as the depth increases.

The four-track subway through the station at Hoyt St. occupies nearly the whole width of the street between building lines between average depths (in the open trench portions) of 5 ft. and 22 ft. below the curb. It is therefore necessary to do a considerable preliminary work in underpinning the front walls of adjacent buildings, removing sidewalk vaults, moving gas and water pipes and electric conduits and in rebuilding sewers. The pavement is removed for the full width of the street and is replaced by a wooden deck about 25 ft. wide in the center with open spaces each side, which are protected by substantial hand rails and afford opportunity for the delivery of materials and the removal of spoil and admit light and air to the excavation. At street crossings the whole width of the trench is temporarily decked and some special extensions are made to the center deck at the entrances of large stores to facilitate the street car traffic.

The pavement is removed in successive half-width sections about 20 ft. long, operations being conducted with the following sequence: First, the stone paving blocks between the rails of each of the two street car tracks are removed and transverse deck planks 3 in. thick are laid there on longitudinal 4x6-in. planks close together on 6x6-in. cross ties. Second, a shallow excavation is made between the tracks and from it two pairs of center longitudinal 8-in. I-beams in 22 ft. lengths with overlapping joints are worked into place both sides of the trench to carry the inner ends of the ties. The I-beams are blocked up from the bottom of the excavation and the deck planks between the tracks are laid. Third, the excavations marked 1 are made outside the tracks and the remainder of the wooden deck is laid with 4x6-in. planks. At street crossings these planks are laid longitudinally on transverse beams and the trench is sheeted and braced. Intermediate between crossings the planks are laid transversely and bridge over the space between the rail ties and the longitudinal beams supporting elevated railroad towers. The remaining four lines of longitudinal I-beams under the outer edges of the street car tracks, and 10x10-in. longitudinal timbers J, in 22-ft. lengths, are put in before the deck planks are laid by the regular timbering gang, who lay it in successive longitudinal halves to avoid unnecessary obstruction to the traffic.



Successive Excavations.

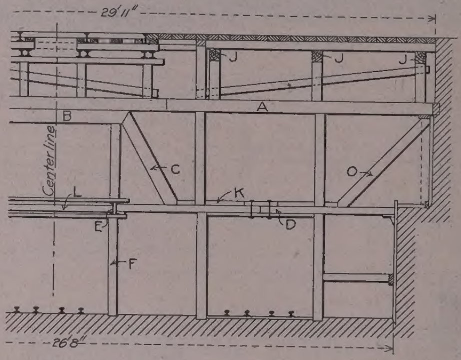


Two-Track Subway Widened to Four-Track.

In the fourth operation a full width excavation 2 is made under the deck to a depth of about 6 ft., the deck beams being carried on blocking until their permanent vertical posts are put in. Full length 12x12-in. horizontal braces A, made of 6x12-in. timbers with staggered butt and bolted joints are laid on the bottom of the excavation with their ends bearing against rangers, and serve both to tie the bracing together and as sills supporting the vertical shores under the deck beams. The 12x12-in. crown timbers B of the center arch are set simultaneously with timbers A, and the sides of the trench are sheeted with 2-in. permanent square-edge sheet piles driven by hand in 12 to 15 ft. lengths as the excavation progresses. In the fifth operation excavations 3-3 are made and the beams A are maintained on blocking until the 6x12-in beams D-D in 10-ft. lengths are put in place and spliced by the thrust blocks K, and the inclined side braces and arch races O and C are set.

In the sixth operation excavation 4 is made and pairs of 12-in. channels 10 ft. long, with staggered butt joints, are bolted together, back to back, to make continuous I-beams, E-E, and are set in position with horizontal transverse struts, L between them. Vertical shores are set on the channel beams to support the timbers B, after which the rakers can be removed, but are retained for braces. In the seventh operation a "Dish," 5, is excavated on the center line to allow the spoil tracks to be extended at sub-grade as close as possible to the heading. The sides of the dish are not sheeted except in very bad ground, and excavations 6-6 and the setting of the lower tier of vertical shores without interfering with the upper stories of timbering complete the eighth operation. All the spoil from excavations 5 and 6 is loaded into the cars by shovelers. All the rest of the material excavated except from excavation 1 is loaded by the belt conveyors.

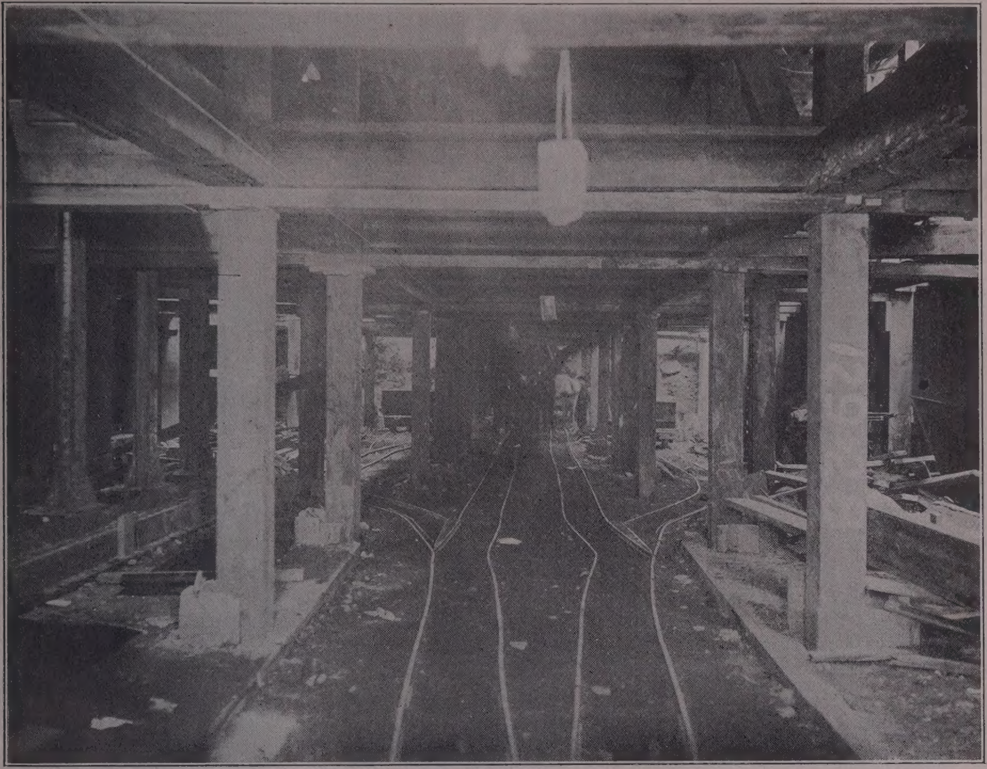
In designing this system special care was taken to locate the vertical timbers so as to clear alternate 5-ft. sections of the finished subway construction, to reduce the lengths and sizes of the timbers so that nearly all of them can be handled by two men, and to frame them to standard dimensions so that as the excavation and concreting progress timbers taken out in the rear are carried forward and used again without cutting or fitting.



Half Cross Section and Timbering.

A 30-in. cast-iron water main has to be removed and is broken into pieces which can be handled by means of a 40-ton hydraulic jack set inside near the open end in a vertical position. By its operation the pipe is first sprung ⅜-in. or more, and pieces broken off the top, after which the sides and bottom are broken up by hand by sledging. The pipe is made of high grade iron and is covered with large tubercles.

Spoil is loaded in 1-yd. square steel bail-dumping buckets made by the G. L. Stuebner Iron Works, Long Island City, and moved from the heading to the derrick on small flat cars drawn by mules. The 18-in. gauge spoil tracks are kept at sub-grade and are very conveniently located, as shown in the diagram, so as to provide a double-track service for each of the three headings which are virtually involved in the four-track construction, and at the same time clear the timbering and connect with a double track line through the finished subway. The tracks are arranged so as to require the minimum amount of moving or shifting of switches and crossings and the changes are easily made by simply extending and reducing the lengths of the branches and shifting the switches in the center pair of tracks as fast as the latter are changed from narrow to wide spacing, about every 50 ft. Two cars are delivered at the heading on each track, so that one is always being filled while the other is waiting or is being removed.



Spoil Tracks in Completed Excavation.

Two 18-inch Gandy conveyer belts about 20 ft. long, each driven by a ½ h.-p. Sprague electric motor, are arranged tandem in excavation 4 and are served by shovelers from excavations 2, 3 and 4. They deliver continuously through a pivotal reversing chute to either of the rear cars on the two center tracks. The forward cars on the same tracks are filled by shovelers making excavation 5, so that the tracks can be extended as rapidly as possible. Similar pairs of belt conveyors are installed on each side in excavations 3-3, and deliver the spoil from excavations 2 and 3 to the rear cars on the pairs of outside tracks. The forward cars on the same tracks are filled by shovelers working at the transverse heading in excavations 6-6. The spoil cars are drawn singly by mules a maximum distance of about 1,200 ft. to openings left in the roof of the finished subway, through which the buckets are hoisted by steam stiff-leg derricks in the street and dumped in standard gauge 20-ton flat cars on the tracks of the Brooklyn Rapid Transit Railroad Co.

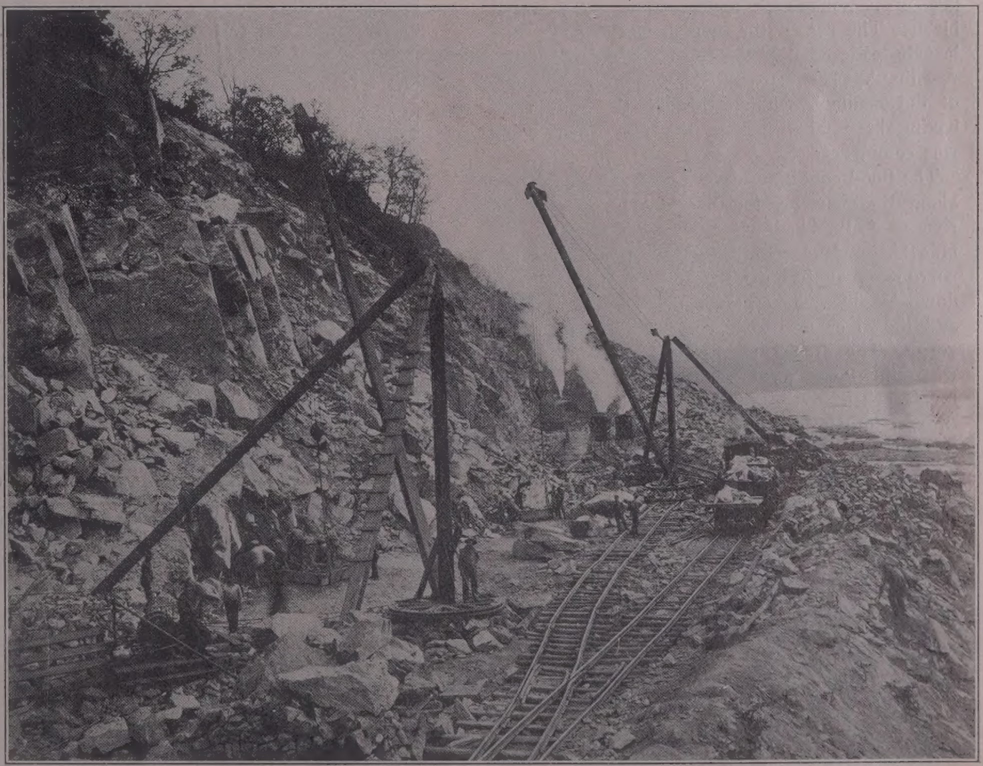
The average excavation is about 50 cu. yd. per lin. ft. of four-track subway and with a force of about 20 shovelers, four drivers, one derrick man, three men to attend the belt conveyors, one foreman and four mules, an advance of about 5 ft. being made in each 10-hour day. The belt conveyors are of a special pattern with rigid light pedestals so that they can be easily and quickly moved and adjusted as units. They were designed by Mr. R. N. Cranford and are considered to give excellent satisfaction and each set saves the work of from 8 to 10 shovelers, besides causing much less obstruction than the men they displace. In tunnel work they also have the important advantage of not vitiating the air as would laborers. Each belt is mounted on a light framework with longitudinal girders braced together, forming a rigid base, which can be easily moved and adjusted. The belts under these conditions last about about two months each.

(To be Continued.)

ELECTROLYSIS in Cleveland destroyed 24 service pipes in 1904, according to Supt. E. W. Bemis, of the water department. Of the 32 breaks, 24 were from settlement of sewer trenches.

The Low Grade Freight Cut-off of the Pennsylvania R R.—II.

There was no possibility of bringing a steam shovel in to work at the level of the new line at either the point of the big blast, nor the heavy work beyond it. The new grade was 150 ft. above the river and 100 ft. above the old track, the face of the cliff rising very abruptly on all sides. A standard-gauge track was laid from the Columbia & Port Deposit R. R. near the creek crossing up the valley of the creek into the interior, and then up steep roads to the top of the hills above the river in which the cut for the new tracks is being made. This track was extended nearly 2 miles, finally reaching the upper end of the valley between the site of the big blast and the heavy work between the latter and the creek. An 80-ton Marion steam shovel was hauled out to the end of this track, which contained many sharp turns and grades of considerable length as steep as 15 per cent. The shovel was then lowered to the grade of the new tracks and started to work, being required to cut its way through the ends of abrupt hills in various places before it could be taken down. Another 80-ton Marion shovel was hauled up this track for some distance and then over a branch track to the top of the hill at the creek crossing. A large part of this branch was laid on a new road which was built on a uniform grade of 14 per cent. for some distance. The shovel was started at work 350 ft. above the river around the end of the hill. It worked its way to the front of the hill, taking a side cut about 30 ft. deep, off the latter. After it had reached the river face of the hill and continued several hundred feet parallel with the new line, it was turned around and started back on a descending grade; the cut made on this descent continued around the end of the hill, the material from all of these top cuts being hauled back inland. When the shovel was finally back around the end of the hill and about 30 ft. lower than the level at which it started, a return trip was commenced on a grade descending in the opposite direction. In this manner the shovel worked



Handling the Top-Lift of a Heavy Rock Cut With Stiff-Leg Derricks.

its way down to the level of the new tracks. Much of the material removed in getting the shovel down to the desired level would have to have been removed from below by blasting, or otherwise, if the shovel had not been placed in this manner. Furthermore, it was a case of getting the material removed in the shortest possible time consistent with reasonable expense.

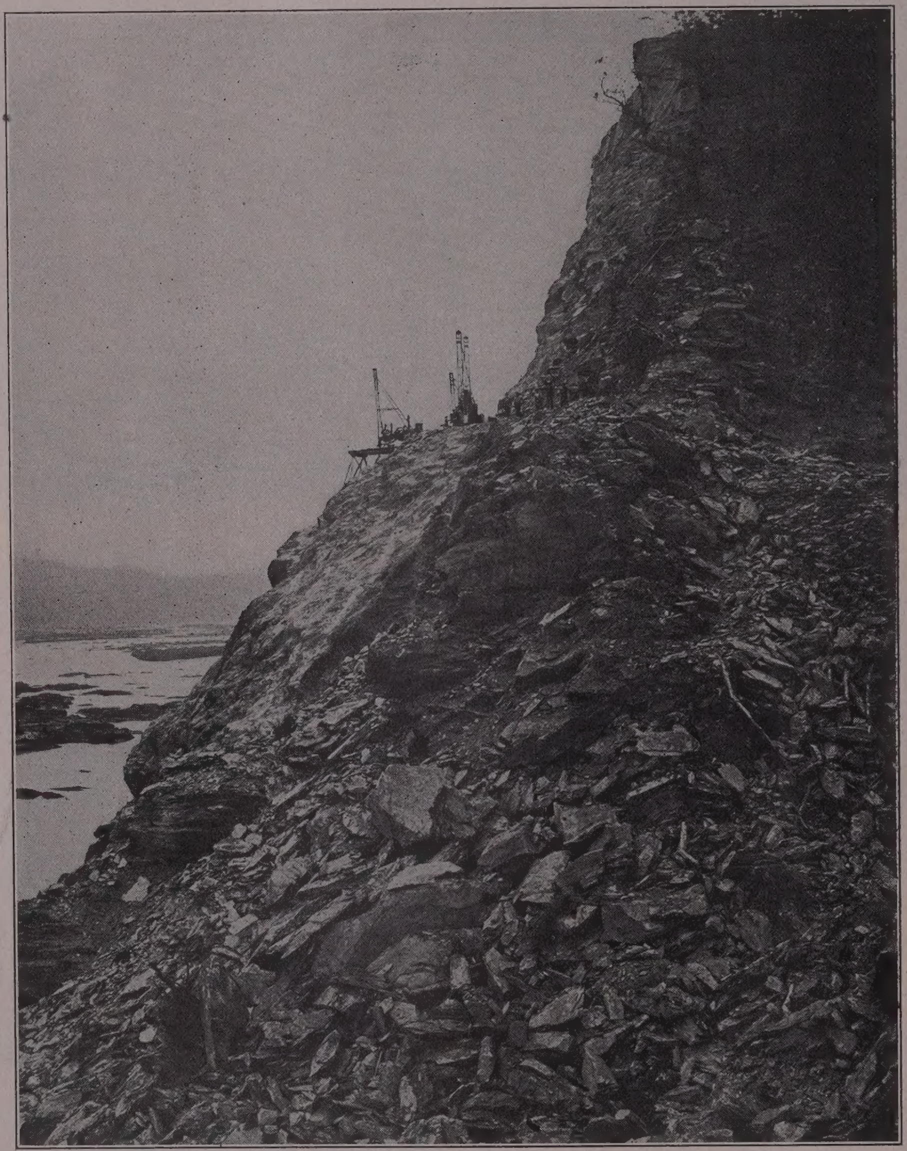
The narrow-gauge engines and the dump cars used in connection with these shovels and many of those at work farther up the line were hauled inland on specially built trucks. The flanges were knocked from the wheels of an old standard-gauge car. The pairs of wheels were left on their old axles and the axles placed on 10-ft. centers. Two 12x12-in. timbers were then mounted lengthwise on these axles, the inner edges of the timbers being set 3 ft. apart, which is the gauge of the small engines and cars. The latter were then loaded on these trucks and hauled over the country highways to as near their desired location as possible. Those for the shovels farther up the line were taken out near the edges of the cliffs and lowered down to the shovels with triple blocks and cables.

The use of derrick well drills in preference to the standard rock drills in the class of work encountered in this portion of the line is considered to be more than justified by the results that have been obtained. The work has largely been a case of practically pushing aside portions of the cliffs, and at the same time breaking up the rock so that what remained within the slopes of the cuts could be handled by steam shovels with a minimum amount of work subsequent to the initial blasts. The rock drills have, of course, been indispensable auxiliaries to the well drills in blasting roads on which the latter could be brought to the work and in removing projections and making holes for small blasts. The use of the well drills, however, has largely made possible the exceedingly rapid progress that has been accomplished, about 90 per cent. of the 7-mile bench cut through the solid rock having been taken out in the year since work was commenced.

The flood conditions in the Susquehanna River along this part of the line are peculiar. The river at Columbia is 2.0 miles wide, while a few miles below the mouth of Conestoga Creek it narrows down to a width of 300 ft. Ice coming down in the spring gorges in this narrow valley and the river backs up very rapidly above the gorge. The creek valley is quite narrow, and when the flood backing up from the gorge below reaches it, the whole flow of the river is thrown into it with great force. The Columbia & Port Deposit R. R. formerly crossed the creek on six very heavy 30-ft. masonry arches. An exceptional flood in the spring of 1904 lifted these arches from the footings under their skewbacks and turned them over, almost intact. A large highway bridge farther inland was picked up and carried over a mile by the flood, and buildings were wrecked all along the valley.

The tracks of the new line cross the creek 100 ft. above the highest known flood level on a double-track steel viaduct, 1,560 ft. long, on which the base of rail is 147 ft. above the normal river level. This viaduct has a 300-ft. span over the creek, carried on masonry piers, 105 ft. high. At one end of this span is 480 ft. of viaduct, with 780 ft. at the other. The reconstructed Columbia & Port Deposit R. R. will cross the creek 55 ft. above the normal river level on three spans supported on two piers in the stream and on an abutment at each end, built on the river side of the piers of the 300-ft. span of the new line bridge. The abutments of the lower bridge will have wing walls which will be continued for some distance up and down the river at the height of the bridge seats. The towers of the viaduct are on high masonry footings, whose tops are level with the tops of the abutments and the wing walls. A fill will be made back of the latter to nearly the tops of the footings for the towers.

The old grade of the Columbia & Port Deposit R. R. around the base of the ledge through which the bench for the new line has been cut has been completely buried by the blasting. The relocation of that road on a bench built out from the lower slope of the bench carrying the two tracks of the new line will be made with difficulty. Its new grade will vary from 20 to 50 ft. above the river. The rock slopes of the cuts for the tracks of the new line extend into channel of the river in some places, and the latter is very deep along them. A single track will be laid for the old line at first, with the expectation that a second track will be added eventually.



Well Drills at Work on a 230 Ft. Cut after the Removal of Three 30 Ft. Lifts.

The new line continues along the side hill parallel with the river for 1.25 miles from the creek crossing. Its grade is 150 ft. above the river and its center line 200 to 300 ft. back from the latter and 75 to 100 ft. back from the face of the cliff, which rises 50 to 230 ft. above grade. No difficult work was met, however, in the first ¼ mile from the creek. But about that distance from the end of the viaduct one of the heaviest pieces of excavation on the whole line was encountered, where a cut, 2,000 ft. long, in solid rock, is being taken out. The top was blown off in small blasts in rock drill holes. Well drills then sunk holes 80 to 100 ft. deep and the remainder of the rock was disturbed in large blasts. Nine stiff-leg derricks were first set on the top of the cut and the larger stones were lifted out and cast over the side of the hill by them. A 70-ton Bucyrus steam shovel is at work against a face of about 50 ft. in each end of the cut, bringing it to grade.

Beyond this cut is a thorough cut in rock, 500 ft. long, with narrow gulches on each side of it, 60 to 100 ft. deep. A thorough cut, 1,300 ft. long and 200 ft. deep at the center, is separated from this last cut by one of the gulches. A deep ravine is beyond the 1,300-ft. cut, across which a fill 90 ft. high had to be made to bring it to grade. Two 70-ton Bucyrus steam shovels were brought up this ravine on tracks built from the Columbia & Port Deposit R. R. at the river. Both shovels were brought part of the distance on a track laid on a highway and then on tracks laid on newly constructed roads, one on each side of the ravine. These new roads contained grades as steep as 25 per cent., and even with such heavy grades one of the roads had to be built as a switchback, to get the shovel up to the new line. The fill across the ravine has been made in three lifts from pole trestles, the narrow-gauge tracks from the steam shovel working in the big cut being laid as switchbacks to get down to the first and second lifts.

A 30-ft. masonry arch, 230 ft. long, is built through the fill and will carry a highway. This highway is the first one crossed after leaving Columbia. There are no grade crossings on the entire new low-grade line, however, as all highways are either carried over the tracks on bridges, or under them through arches.

The shovel working from the east end of the 90-ft. fill had a small cut, 600 ft. long, of 20,000 to 30,000 cu. yd. to make. Beyond that cut is a fill 2,200 ft. long and 135 ft. high at the center of the valley which it crosses. Most of the material for this fill was obtained from a solid rock cut beginning about 2,000 ft. from the east side of the valley. The fill was too high to attempt to make it by dumping from a pole trestle the heavy rocks brought out of the big cut. The narrow-gauge track on which the materials were hauled out from the latter were therefore extended around the end of a hill rising from the valley and worked out, first on one side and then on the other, as the fill advanced from the hill.

A Deep Thorough Cut in Solid Rock Where Line Leaves the River.

The solid rock thorough cut, from which the material for this fill was largely obtained, contains 380,000 cu. yd. of material in less than 1,300 ft. and has a maximum depth of 92 ft. at the center line. The rock in it contains many sand pockets, making it hard to load properly for blasting. A 30-ft. open cut was first removed and then a 60-ft. thorough cut was started, which is bringing the line to grade. A 70-ton Bucyrus steam shovel is at work in each end of the cut. A 20-ton Marion steam shovel is also at work in the end toward the high fill, as some earth cutting is encountered there.

A standard-gauge tramroad was laid up the ravine, over which the 90-ft. fill was made in three lifts, and then up a valley branching from it, finally reaching the end of the 380,000-yd. cut. This road rises 150 ft. in a mile, most of the ascent being made in the last half of the distance. Much of the plant and materials used in carrying on the work has been brought in over this road.

A 1,200-ton stone crushing plant, for making ballast, has been installed near the end of this road at the only place within 15 miles along the line where good rock could be obtained and a plant erected at grade. The plant contains 3 crushers made by the Farrell Foundry & Machine Co. Each of these crushers is belted to a 50-h.-p. Erie engine, the engines being placed in a separate room. The whole plant is permanently built, and as its supply of good stone is unlimited, it will doubtless be kept in operation after the new line is completed. The contractor has also erected a dynamite factory in this vicinity which has supplied much of the dynamite used in blasting.

A High Fill Made With Material From a Rock Cut.

The material from the east end of the 380,000-yd. cut is being utilized in a fill 90 ft. high beyond it, the tracks from the steam shovel in the cut being laid as switchbacks along the side of the hill until the fill was brought to grade. Beyond this fill is a 240,000 cu. yd. cut in less than half a mile; this was taken out with a 70-ton Bucyrus steam shovel, which had been hauled nearly 5 miles from the railroad to get it in place. The first 3.5 miles of this distance the shovel was brought up on the track of an electric line under its own steam, hauling a car containing its boom and dipper at the same time. A branch track was then built from the trolley road, across a creek on a temporary trestle and up a long steep hill, the grades on the track laid on the latter being from 10 to 20 per cent.

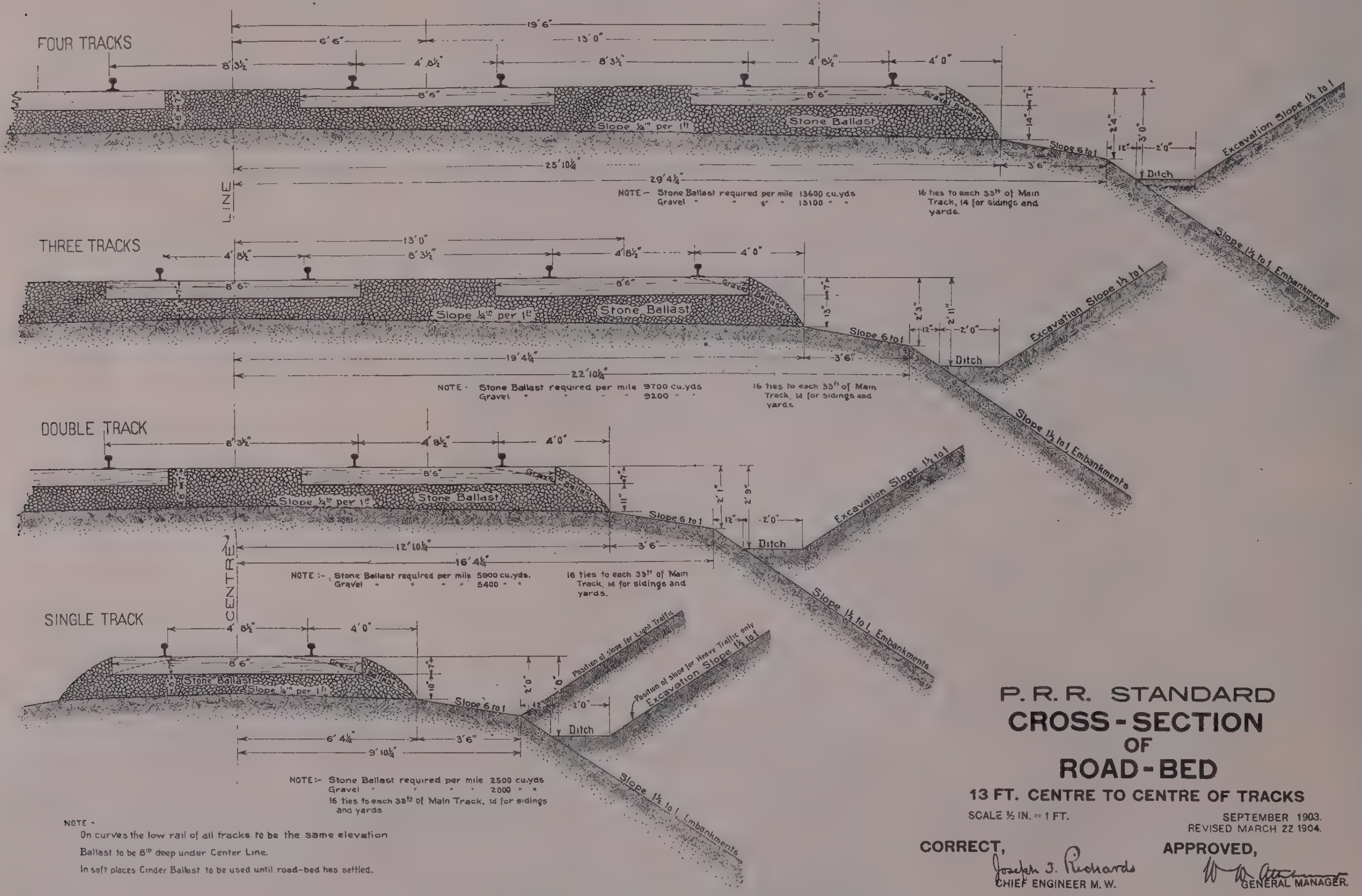
Just beyond this cut is the deep valley of Pequa Creek, which the tracks of the new line will cross about 140 ft. above the bed of the stream. This crossing is made on a steel viaduct 590 ft. long and 136 ft. above the water. The viaduct has a span of 100 ft. over the stream, with 210 ft. of viaduct at one end and 280 ft. at the other. It is built on masonry piers and was erected as soon as possible after the inception of the work, so the work beyond the creek could be carried on with greater facility.

The face of the creek valley on the side opposite the 240,000-yd. cut is solid rock and rose practicaly straight for 230 ft. above the stream and 90 ft. above grade. This hill extended back for 1,400 ft., so it was impossible to approach it, except from the interior. In this 1,400 ft. 340,000 cu. yd. of material was within the slopes of the new line. A second 70-ton Bucyrus steam shovel was hauled up the trolley road 3.5 miles, and then for over a mile up a valley parallel to the line. At the end of this distance it was started back and hauled up on the hill. The air line from the central station was not extended to this cut and the rock is being removed in 4 lifts. The excavated material from the top lifts and all of that from the inland end of the cut is placed in a big fill beyond. As soon as the viaduct was finished and the 240,000-yd. cut made, the shovel in the latter was taken across the viaduct, and the rock loosened in that end of the 340,000-yd. cut loaded in dump cars, which are hauled out over the viaduct and dumped on the other side. The engines and cars for both shovels in the big cut were hauled up the trolley line and then inland over the new roads, a third rail being laid on the trolley road.

From the end of this big cut, which is about

3 miles from Shenk's Ferry, the construction work continues to be very heavy clear through to the junction with the old line at Atglen, just west of Parkesburg. The cuts are mostly all in earth, however, and the contractors are handling them in the usual manner of moving heavy earthwork. The new line tracks generally follow the tracks of the old line from Atglen to Glen-Hock, although in places they are ¼ mile or more from the latter. The new line crosses the main line three times in this distance, and owing to its low grades and the heavy grades on the main line one of these crossings is overhead and the other two undergrade.

The construction of the new low-grade line is under the direction of Mr. W. H. Brown, chief engineer of the Pennsylvania R. R. Mr. J. F. Murray, assistant engineer, has immediate supervision of the work, and Mr. J. P. Temple, resident engineer, is directing the field work between Columbia and the end of the heavy rock work at Martic Forge.



Standard Cross-Section of Road-Bed Adopted by the Pennsylvania R. R.

Practically all of the new low-grade line from Marysville to Glen Loch has been or is being built by H. S. Kerbaugh, Incp't., of Philadelphia. The heaviest force of men and the largest amount of plant employed on any of the work has been between Columbia and 3 miles west of Shenk's Ferry, where in a distance of 18 miles 4,000 to 4,500 men have been on the ground almost since the inception of the work. Much of the drilling, blasting and excavating has been carried on night and day, and exceptionally rapid progress has been made, as high as 820,000 cu. yd. having been taken out in a single month. This portion of the work is divided in two sections: one extending from Columbia to Safe Harbor, including most of the heavy side-hill cutting; and the other from Safe Harbor to 3 miles east of Shenk's Ferry, including the power station, the two viaducts and the heavy through cuts. Mr. Wm. B. Gray is superintendent of the former section, Mr. Walter R. Cliffe is superintendent of the latter. These gentlemen have also directed, for the contractor, all of the construction work west of Columbia to Marysville. A central office in which all of the accounting connected with the work is handled, has been established at Safe Harbor, and is under the direction of Mr. J. W. McWilliams.

The Rateau Low-Pressure Turbine.

The starting up of the Curtis turbine at a Philadelphia power plant, running on exhaust from reciprocating engines, lends special interest to a translation by Chief Engineer B. F. Isherwood of a paper by Mr. J. Rey on the applications of the Rateau turbine. This appears in the "Journal" of the American Society of Naval Engineers of last month, and contains the following note concerning a French system of this nature.

If steam be taken of atmospheric pressure, representing about 26.6 cu. ft. per pound weight, and if this steam be expanded to the pressure in the condenser, or to about the pressure of 1.4 lb., the weight of steam consumed per theoretical horse-power is about 17 lb. per hour. The multicellular steam-turbine in proper adjustment and utilizing the steam in these conditions, has an economy surpassing 60 per cent. and can attain even 65 per cent. The effective horse-power upon the shaft under these conditions represents a consumption of about 26.8 lb. weight of steam per hour.

If the turbine be replaced by a piston steam engine, not only will the dimensions of this motor be, for equal power developed, enormously disproportionate, but its economy, by reason of its frictions and thermic losses, will be extremely low. The dimensions of the turbine, on the contrary, are far from increasing in proportion to the volume of the steam to be utilized. Only the sections of the distributors should be calculated so as to allow the total flow of steam to pass at a convenient speed.

Struck by these advantages, Mr. Rateau sought to combine the turbines with stationary steam engines without condensation; that is to say, with piston steam engines pumping out mines, and piston steam engines working rolling mills. Nevertheless, there is one difficulty: the machines in question, being of intermittent functionment, the interrupted flow of steam from them has to be regulated, as otherwise the turbine could not be employed under these conditions.

The ingenious accumulator-regenerator of steam, designed by Mr. Rateau, has completely solved this problem, according to Mr. Rey. It transforms a discontinuous flow of steam into a continuous flow, whatever may be the prime motor.

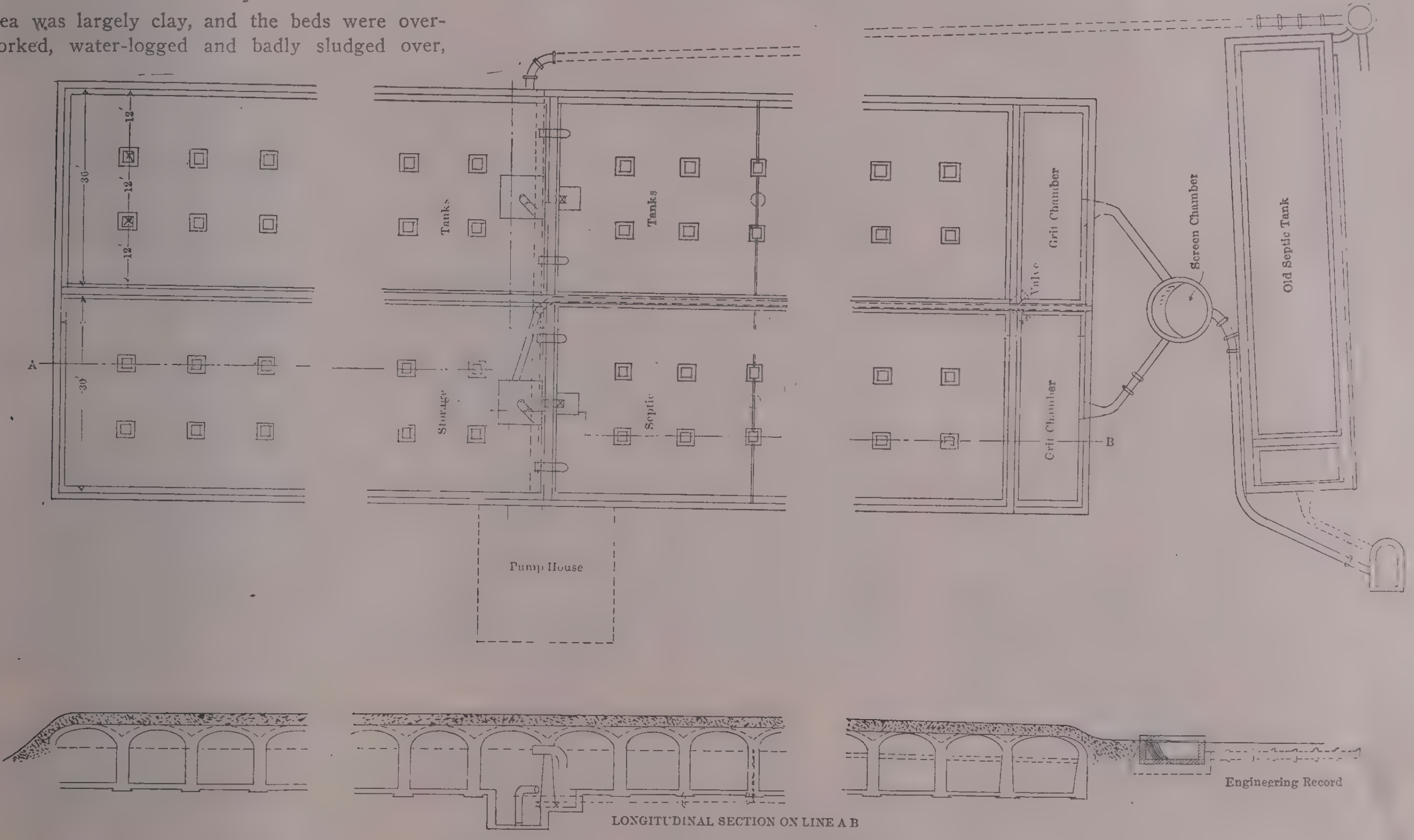
A low-pressure turbo-generator of 300 h.p. was erected in the mines of Bruay, in 1902. The turbine uses the exhaust steam of a piston pumping engine and expands it down to the condenser pressure. At the mean speed of 1,600 r.p.m. the turbine works two dynamos placed at the end of the shaft. When the pumping engine is not in use, steam is furnished to the turbine by the boiler, and is expanded from its entrance by means of an automatic expanding arrangement.

Steam is delivered to the turbine at 14.365 lb. absolute and the condenser pressure is 2.617 lb. absolute. The steam consumption is 37.37 lb. per electrical horse-power per hour. This figure, determined by test, is slightly under the makers' guarantee of 38.36 lb.

Sewage Disposal at Berlin, Ont.

A sewage disposal plant, comprising two septic tanks, two storage tanks, a pumping station and 14 acres of intermittent sand filters, has recently been completed at Berlin, Ont. The population of Berlin is approximately 12,000 and the town is served by 19 miles of sewers. The house sewers are separate from the storm-water drains, but considerable quantities of street washings enter them through the gratings in manholes. The average daily flow of sewage is about 500,000 gal., of which more than 200,000 gal. is wastes from factories, and all of which is treated in the disposal plant. A brewery, a felt and woolen factory, a gas works in which gas made from petroleum and four tanneries, discharge wastes into the system that give the greatest trouble.

A disposal plant consisting of a covered 17x68-ft. septic tank with a capacity of 60,000 gal. and 12 acres of intermittent land filtration area had been in service for some years. The filtration area was largely clay, and the beds were overworked, water-logged and badly sludged over, until practically all aerobic bacterial action in them had been stopped. The brewery sent down grain husks which interfered seriously with the operation of the tanks and beds. Considerable quantities of fats are extracted in the process of manufacture in the felt and woolen factory, and the wastes from the latter were turned into the sewers without any attempt to remove these fats. The waste from the gas works had contributed a tarry oil which spread over the surface of the beds, and also a certain amount of creosote substance which crippled the bacterial functions in the septic tank. The four tanneries use various processes and contribute widely different kinds of wastes, including tannins, lime and lime liquors, chrome liquors, a certain amount of acids and, worst of all, finely divided pieces of tan bark. The effluent from the filtration area was turned into a creek whose minimum flow is not more than 1,000,000 gal. a day. The water of the stream contains iron with which the various chemicals in the sewage formed highly colored precipitates, adding to the noxious conditions produced by turning partially purified sewage into the creek.



Plan and Cross-Section of Septic Tanks and Storage Tanks, Berlin Disposal Works.

Extensive experiments were made by Dr. John A. Amyot, provincial chemist of Ontario, prior to the making of any plans for the new work, in order to determine the best methods of purifying the sewage, consistent with reasonable expense for first cost and operation. A series of tests were also conducted at each of the factories to discover if possible, methods of excluding from the sewers the most detrimental part of the factory wastes. The experiments with the various types of sewage disposal plants were carried out on comparatively large scales, and showed that proper treatment in septic tanks followed by filtration through sand would produce highly satisfactory results, if the more objectionable parts of the factory wastes were excluded.

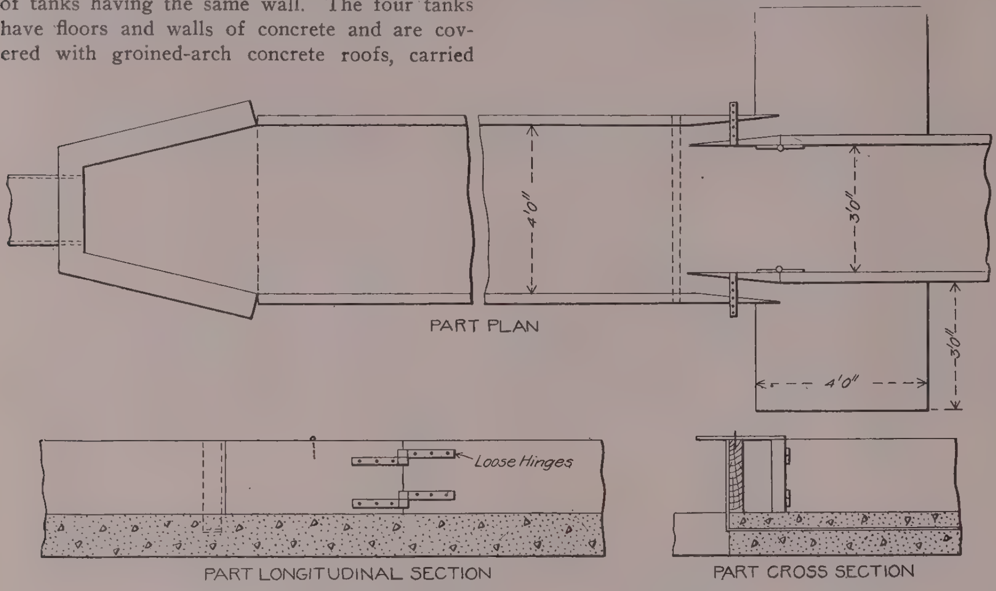
Sewage was passed through the old 60,000-gal. septic tank at the rate of 100,000 gal. per 24 hours. The inflow from the sewer outfall contained on the average during a test extending over nearly 2.5 months the following characteristics: Free ammonia, 2.329; albuminoid ammonia, 1.93, and oxygen consumed, 54.48 parts per 100,000. The effluent from the tank contained per 100,000 parts, free ammonia, 2.223; albuminoid ammonia, 1.057; oxygen consumed, 32.37. An 1,800-gal. tank, a duplicate of the large tank, was operated at the rate of 1,800 gal. a day during the same time. The results from the small tank operated at the slower rate showed an increase of 7.5 per cent. in the removal of albuminoid ammonia and 10.1 per cent. increase in the removal of oxygen consuming materials, as compared with the results obtained from the larger tank at the higher rate. This indicated that a septic tank to treat the Berlin sewage should have a capacity equal to a 24-hour flow. The outlay made in supplying more tankage capacity was considered to be repaid by the increased efficiency of the plant. The new tanks have a combined capacity of 450,000 gal., and the old tank is also available for service.

Experiments were also made with four contact beds treating the effluent from the large septic tank. One of these beds had an area of 0.00125 acre, and the other three each 0.005 acre. The small bed contained 3 ft. of hard 1-in. coke, underdrained with 4-in. tile. It was run at the rate of 712,000 gal. per acre per 24 hours. The other three beds contained 3 ft. of gravel, varying in size in the different beds, and covered with 3 in. of sand. They were run at rates varying from 374,000 to 773,000 gal. per acre per day. three aplications a day being made during part of the experiments and two a day during the remainder. At no time was the effluent from any of these beds non-putrescible. The bed with the smallest gravel always gave the best, and the one with the coarsest, the poorest effluent. There was no appreciable difference in the results whether two or three applications a day were made.

An excellent quality of sand was found to underlie considerable areas in the vicinity of the septic tanks, being a few inches under the surface, but it was 40 to 50 ft. above the level of the tanks. From the results of the experiments decision was made to build intermittent filter beds on these sand areas and to pump the effluent from the septic tanks to them.

The tests carried on at the factories indicated that settling tanks could be built and operated for slight expense, which would greatly improve the objectional manufacturing wastes. The system of gas manufacture has been changed to a carborated water and producer gas process in which all by-products are utilized. The connection with the sewer has been cut off and the waste water from the gas works is turned into a natural water course. Merely screening the effluent from the brewery was found to remove the objectional material from the waste from the latter. A storage basin at the woolen factory, giving time for the settlement of the sludge and baffled at the top to remove the fats, was found to serve the purpose there. With tanks having a capacity equal to the 24-hour flow from the tanneries as much as 40 per cent. of the organic matter in the tannery wastes could be settled out and the various chemicals in these wastes would greatly neutralize each other at the same time. Construction to achieve these results has been undertaken at the various factories during the building of the new disposal plant.

The two new septic tanks are each 36x136 ft. in plan, and are built with one side wall common to both. A 36x150-ft. storage tank is built at the effluent end of each tank, the adjacent ends of tanks having the same wall. The four tanks have floors and walls of concrete and are covered with groined-arch concrete roofs, carried by the walls and by piers built up from the floor. The roofs have 2 ft. of earth filling over them. A 12x36-ft. grit chamber is built at the inlet end of each septic tank and is separated from the latter by a concrete wall extending 12 in. above the normal level of sewage in the tanks.

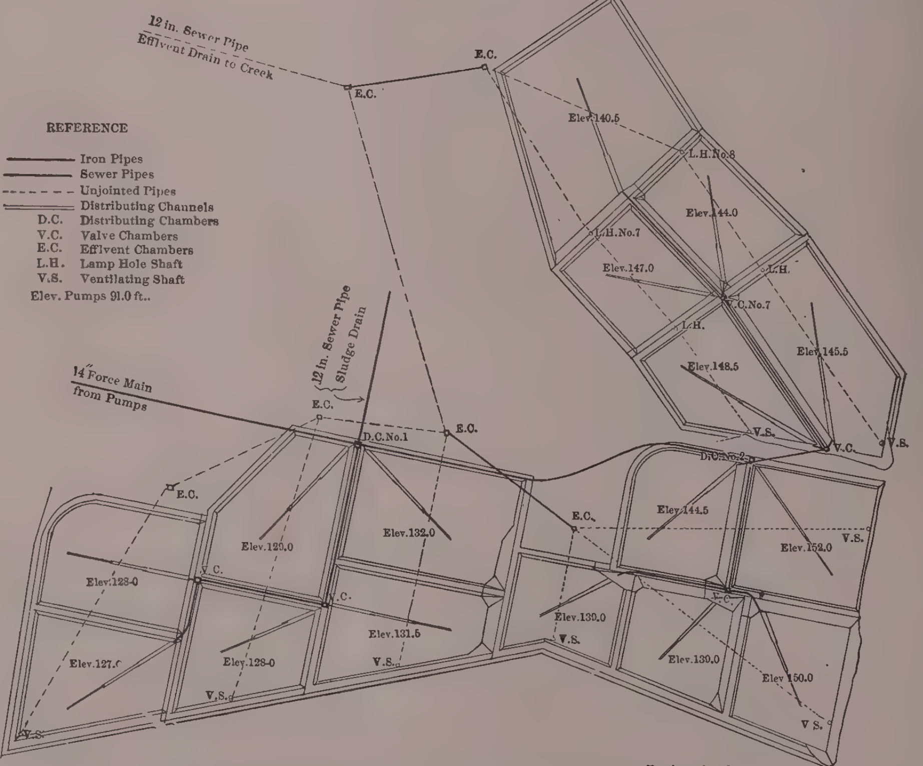


Details of Distributing Channels for Filter Beds.

The outfall sewer terminates in a brick wall from which the sewage flows to the old septic tank and to a circular screen chamber built at the inlet end of the new tanks. The screen chamber is connected to the center of the side of each of the grit chambers by a bell-mouthed pipe, submerged below the level of the sewage in the tank. The sewage flows from each grit chamber to the tank with which the latter is connected through three semi-elliptical openings in the wall between the chamber and the tank, the openings being just below the surface of the sewage in the tanks. The floors of the tanks slope from the inlet end to the outlet end, the normal depth of sewage at the former being 6.5, and at the latter 7.5 ft. The outlet from each septic tank is two 18-in. half-bent pipes, with their horizontal legs through the wall separating the septic tank from its storage tank, and the end of the vertical legs submerged 4 ft. below the surface of the sewage in the former. Each of these outlet pipes is placed 6 ft. from the side wall. Midway between them on the center line of the tank is a sump connected through the end wall to a sump in the storage tank, by a pipe controlled by a valve operated from the surface of the fill over the tanks. Each grit chamber is also connected at the bottom to the sump in the storage tanks by a 14-in. cast-iron pipe laid in the division wall between the septic tanks.

An 18-in. vitrified-clay pipe also connects the old septic tank with one of the storage tanks. A connection between the brick chamber at the end of the outfall and this 18-in. pipe enables the three septic tanks to be by-passed. Any one of these tanks may also be thrown out of service.

The flow from the septic tanks will be allowed to pass into the storage tanks at the rate the sewage comes from the outfall. The storage tanks will be emptied once in 24 hours. Two horizontal, Canada Foundry Co., turbine pumps, with a capacity of 1,000 gal. a minute, placed in a one-story pump house built at one side of the tanks, will elevate the tank effluent through a force main to distributing chambers built in connection with the filter beds. These pumps are each direct-connected to a 90-h.-p. Canada General Electric Co. three-phase, 60-cycle, revolving-field induction motor and are designed to run at 800 r. p. m. A 500-gal. per minute Canada Foundry Co. centrifugal sludge pump is belted to one of the motors, and has its suction in the sumps in the storage tanks. Electric power is furnished by a 100-kw. three-phase, 60-cycle, 2,300-volt Canada General Electric Co. alternating current generator in the municipal power station, 1.75 miles distant. The turbine pumps operate against a total head of from 55 to 75 ft., and each pump can empty one of the storage tanks in 4 hours. A 14-in. riser main leads to the filter beds. The sludge pump discharges on sludge beds 55 ft. above the tanks.



Engineering Record

General Arrangement of Filter Beds, Berlin Disposal Works.

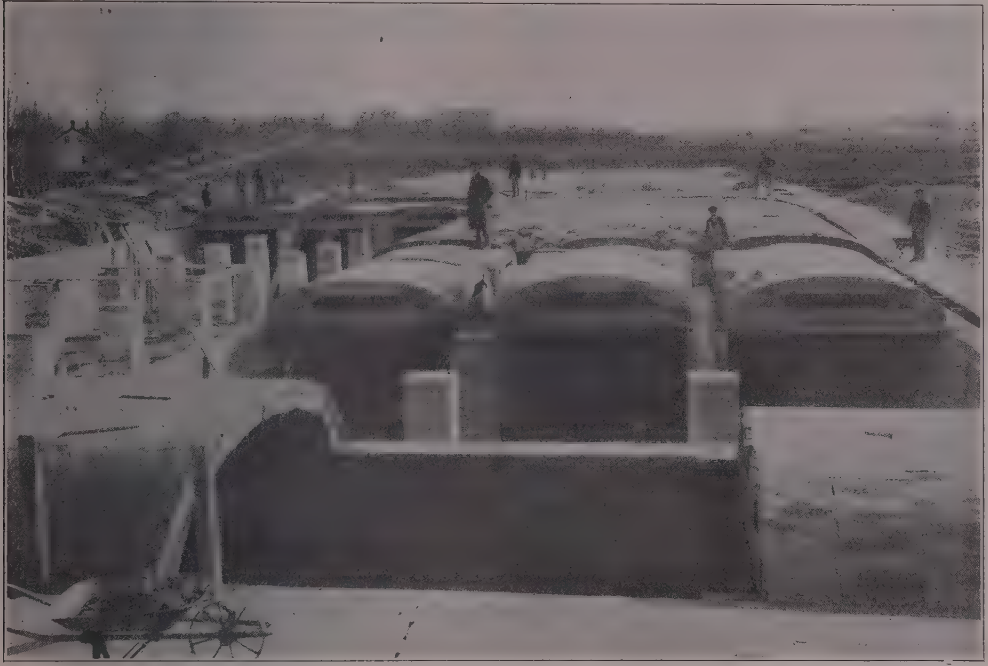
There are 16 filter beds with a combined area of 14 acres. These beds are at various levels, and are supplied by gravity from two distributing chambers, one 55 and the other 75 ft. above the bottom of the sump in the storage tanks. The area on which they are built had a surface layer of loam, 6 to 20 in. thick, under which was a stratum of coarse, sharp sand at least 20 ft. deep. The beds were formed by scraping the loam into embankments around their sides and then leveling off the sand. The excavation and embankment were practically balanced, the former being 75,793 cu. yd. and the latter 74,880 cu. yd.

The two central concrete distributing chambers are built for the 16 beds, one for those at each general level. Valves are provided on the riser main so the discharge may be diverted into either chamber. From each of these chambers 18-in. sewer pipes are laid in the embankments to a valve chamber at each of the beds in the level served by it. The beds are laid out as nearly rectangular as possible, with straight embankments. A distributing channel extends across each bed from its valve chamber, the channels being laid diagonally. A concrete culvert with wing walls built in the embankment, connects the distributing channel with its valve chamber. Each of these channels has a concrete bottom laid with its surface flush with the surface of the bed. The sides consist of 2x10-in. plank set on edge. The plank are held in place by iron rods imbedded in the concrete bottom. The channel is 4 ft. wide at the inlet end and gradually reduces in width to 1 ft. at the distant end. The flow is diverted on the beds through openings made in the sides of the channel. A reduction in width is made at each of the openings, and the plank in the sides overlap at the latter. The outer plank are beveled on the inner side and the inner plank on the outer side. A space 6 in. wide is left at the overlapping ends of the plank on each side. The inner planks are also both hinged 1 ft. from the end, so the width of the openings on each side may be increased, the entrance to the channel beyond the opening being obstructed at the same time. The hinged ends are held in the desired position by an iron strap on the top of each of them, the straps having holes in them in which keys that fit in holes in the top of the outer planks are placed. A 3x4-ft. concrete apron is placed on the surface of the bed on each side of the openings and at the end of the channel to prevent scouring.

The underdrainage consists of a single line of 6 or 8-in. sewer pipe under each bed. These pipes are laid with open joints, 6 to 10 ft. below the surface. These lateral drains connect with main drains which join in a 12-in. sewer pipe leading to the creek. It is not believed, however, that anything like the quantity of water pumped on the beds will reach these underdrains.

The septic and storage tanks cost $18,000; the filter beds and their accessories, $20,000; the pump house $1,050, and the machinery, including the electric generator, the two motors and three pumps, $6,700.

The plant was designed by Mr. Wm. Mahlon Davis, of Berlin, Ont., and has been built under his immediate direction. Mr. Casper Braun was the contractor for the construction of the tanks; Mr. Christian Asmussen for the pump house, and Mr. Philip K. Webster for the beds.



Construction View of the Septic and the Storage Tanks.

THE EFFECT OF CLAY on the tensile strength of Portland cement mortar has been investigated in the laboratory of the Office of Public Roads at Washington, and some rather surprising results obtained. In a 1:1 mortar showing 680 lb. strength without clay, the addition of varying amounts of clay to the sand caused a maximum loss of strength of 50 lb. and no appreciable gain. With 1:2 mortar having 595 lb. strength, 3 per cent. of clay in the sand was accompanied by a drop in the strength to 550 lb., while 16 per cent. of clay gave 615 lb. strength. With both these mixtures the influence of clay was not important. With a 1:3 mortar, the tensile strength increased from 375 lb. with clean sand to 555 lb. with 16 per cent. of clay in the sand and then fell off to 365 lb. with 40 per cent. of clay. In a 1:4 mortar the increase was from 300 lb. with clean sand to 445 lb. with 20 per cent. of clay in the sand, when a falling off commenced that carried the strength down to 270 lb. with 50 per cent. of clay. Further information on this subject will be found in Sabin's "Cement and Concrete."

Government Contracts; Legal Pitfalls and How to Avoid them.—II.

By George A. King and William B. King, Members of the Bar of the Court of Claims.

Representations and Warranties.—A distinguished United States judge in a recent case says: "Where the parties have deliberately put their engagements into writing in such terms as to import a legal obligation, without any uncertainty as to the object or extent of such engagement, it is conclusively presumed that the whole engagement of the parties and the manner and extent of their undertaking was reduced to writing."

The leading government contract case on this subject was decided by the Supreme Court about thirty years ago. Advertisement was made and bids submitted to furnish 880 cords of wood at a western post, and the contract awarded. After this, but before the contract was signed, the contractor cut this amount of wood. The contract varied from the advertisement and bid by providing for only so much wood as might be found necessary for the post and the commanding officer decided that this was limited to forty cords. The government accepted and paid for this quantity and no more. The contractor sued for his losses but was told that all his rights depended absolutely on his contract, and that as he had furnished all that was necessary for the post and had been paid for it, he could get nothing further. The Supreme Court spoke thus vigorously on this point:

"The written contract merged all previous negotiations, and is presumed, in law, to express the final understanding of the parties. If the contract did not express the true agreement, it was the claimant's folly to have signed it."

The rule seems harsh, but it is specially important that contractors should know with what severity it is enforced.

A striking instance of the application of this principle has recently come before the writers in their own practice. Bidders on a large United States engineering contract received specifications stating that certain work must be done by teams, unless "special permission" is given for machine work. The bidders asked of the engineer a few days before the letting: Will this permission be given? He answered that it was a proposition for machines and not for teams. The bids were made on this basis, and the successful contractor, after he had ordered his machines, was told that permission would not be given. Is he bound by the written contract to use teams in the absence of permission otherwise? The principle already cited would hold him, because he signed a contract requiring the use of teams, unless permission is given otherwise. That, in the language of the Supreme Court "is presumed in law to express the final understanding of the parties." Nevertheless, the injustice is flagrant and some relief ought to be granted. No contractor should put himself in position to be subject to any such question. Yet government engineering contracts are often subject to just such uncertainties.

Some instances which have come before the courts, not only of its enforcement, but of certain limitations and apparent exceptions, will now be cited.

Bidders upon a contract for a dry dock at the Brooklyn Navy Yard were referred for information as to the soil to the commandant of the yard. Drawings showing favorable conditions as the result of examinations were exhibited to them, and upon this assurance they bid. The contract itself contained no guaranty of the correctness of the drawings or the character of the soil. It simply designated the place and obliged the contractor to build a dock there. Quicksands, not shown on these drawings, were discovered in the progress of the work, resulting in heavy loss to the contractors. The Supreme Court held with the Court of Claims that the contract was not controlled by the representations on which the contractors bid, but that its own terms governed all the rights of the parties. Although they built the dock on the quicksands at a greatly increased expense to themselves over what either they or the government officers had expected, they were not permitted by the courts to recover any additional allowance from the government. The hardship to the contractor under this decision was so great that Congress later made a special appropriation to reimburse the contractors for all their increased expenses.

In another case, a directly erroneous representation was made in the contract itself, but the government was relieved from paying the contractor's losses by another provision expressed in it. The contract was for dredging in the Cape Fear River in North Carolina. The specifications detailed the work to be done, and the quantities, but provided that the quantities were to be taken as approximate only, the United States to be liable for no errors. Errors costly to the contractor were found and he brought suit for his additional expenses. He was not allowed to recover because he had by his written contract agreed that the government should have no responsibility for its own mistakes.

An opposite decision, showing when the government is bound by its own representations, was reached under a contract for dredging in the Lubeck Narrows in Maine. The specifications here stated that the material to be dredged consisted chiefly of sandy mud and a little gravel Upon attempting to do the work the contractor found that it consisted of stiff and tenacious clay, very expensive to remove. The court held that such a definite statement of fact as this in the specifications constituted a warranty and that the contractor had a right to rely upon this as a correct statement of fact. This contractor abandoned the contract and claimed damages and the Court of Claims sustained his course and awarded damages. The difference between these two cases is that in the former, the contractor expressly agreed that the government should not be responsible for its own errors, while in the latter no such waiver was made.

In the most recent case bearing on this question, the specifications expressly waived the government's responsibility for mistakes or errors in them. Nevertheless, the contractor's claim for increased pay was sustained. While the case arose in the postal service, its principle is applicable to all classes of contracts. The advertisement for the mail messenger service in the city of New York said that the mails were to be delivered from two elevated railroad stations. The specifications said that bidders must inform themselves as to all facts and that no claims for additional pay based on mistakes would be allowed. There were actually four such stations instead of two. The Court of Claims held that the bidders had a right to rely upon such a direct statement of fact contained in the advertisement and that the government could not take advantage of a misrepresentation made by itself of a fact peculiarly within its own knowledge. While this is a limitation in favor of contractors of the harsh rule already announced, it must be remembered that the fact here misrepresented was so simple a matter that there could be no two opinions about it. Probably this favorable rule would not extend to a case where the fact misrepresented was uncertain.

Cases have arisen and are now before the Court of Claims in the writers' practice, where the government is charged with having failed to disclose on boring sheets all information known to its subordinate officers. These contracts declare that the government will not be responsible for inaccuracies in the information. The Courts will have to decide in these cases whether such a provision will relieve the government from responsibility when the information in the possession of its subordinate officers was not put down on the drawings.

When a contractor finds conditions different from those represented in the specifications, what is his duty? A contractor for dredging in the Delaware River found, at a heavy cost to himself, what course the law required of him. The material to be dredged was different from what the specifications required. He notified the officer immediately in charge, and, relying upon his statement that additional compensation would be paid, continued the work. The court admitted that the contractor might lawfully have stopped work, yet he was not permitted to recover extra pay for work not contemplated by the contract, since the government could not be bound by the act of a subordinate officer to pay more than the contract provided. The subordinate officer had no right to bind the government to a new contract at a higher price. This contractor would probably have been allowed additional compensation had he made his complaint to the head of the War Department, instead of confining his notice and protest to the local subordinate.

Cases occasionally occur where a contractor finds in a written agreement some provision overlooked by him or not known to him when he signed the contract. The stringent rule of law admits no excuse for such want of knowledge. The Supreme Court of the United States about thirty years ago had a case before it involving a written contract where the one party alleged that he had not read the contract and did not know what was in it. The Court said of this defense:

"It will not do for a man to enter into a contract, and, when called upon to respond to its obligations, to say that he did not read it when he signed it, or did not know what it contained. If this were permitted, contracts would not be worth the paper on which they are written. But such is not the law. A contractor must stand by the words of his contract; and, if he will not read what he signs, he alone is responsible for his omission."

To relieve from the stringent provisions of this rule, the courts in rare instances, where the written contract by mistake fails to express the meaning of the parties, will give relief from the consequences of the mistake, by reforming the contract. As to this, the rule is positive that it must be clearly proved that the written instrument does not express what the parties had agreed upon as their contract. The Court of Claims has the power to do this in government contracts and has in a few cases exercised the power. Thus a contract was made in 1869 for constructing a bridge at Rock Island. Some of the provisions of the contract varied entirely from the bid and the contractors under these terms were obliged to perform work which the government had not advertised for. This contract was reformed. The expensive work which they had been forced to do at a great loss was treated as outside the contract and they were allowed to recover an additional price for it. The Supreme Court, in reforming this contract said that, "It is not only plain that the contractors, but the officers of the government, were under a mistake." This mutuality of mistake was the ground for reforming the contract.

In another very recent case the advertisement for contracts for imprinting internal revenue stamps upon private checks contained a provision that only a limited number of these contracts would be made to a specified class of contractors. When the Treasury Department drew up the contract, it omitted this provision and the claimant company signed the contract with this omission. Afterward another contract was given to another company which could not have been included under the terms of the advertisement. The second company took away the expected customers from the first contractor and great loss resulted by introducing this competition. The court was asked to reform the contract on the ground that the real agreement of the parties limited the number of contractors, and that the omission of this limit was a mutual mistake. The court declared the case within the rule permitting reformation. That case has gone to the Supreme Court of the United States and must await the decision of that court before it can be certain that it comes within the law on this subject.

A Portion of the Filter Beds, Berlin Sewage Disposal Works.

These instances of the reformation of contracts only emphasize, by showing how unusual this proceeding and how difficult the conditions, the importance of having the contract as drawn exactly correct.

If there is serious doubt about the meaning of representations contained in written contracts, and these doubts cannot be certainly resolved by reference to any of the terms of the contract, the meaning of the doubtful clause is to be taken most strongly against the party drawing it. The Court of Claims has impartially applied this rule to contracts drawn both by the government and the claimants.

Upon a review of the subject discussed in this chapter the following are submitted as rules which ought to guide contractors in their dealings with the government:

1. The contractor must in every instance read his contract carefully before signature, so as to see that it complies exactly with the specifications, advertisement and bid. He cannot be excused after signing it, on account of his misapprehension of its conditions.

2. The contractor must determine in all instances whether statements of fact in the contract and specifications are warranties by the United States or whether the government is free from responsibility for them and the contract requires the truth of them to be ascertained by the contractor.

3. The contractor should not be governed in determining his course by any statements or representations made in advance of his signing the contract, by any officer of the government, as to the meaning of the contract or the course of business under it. He must rely entirely upon the terms of the contract itself.

4. Where the government has a choice of two plans for procedure under the contract the right of the government to insist upon the more difficult and expensive of these alternatives cannot be controlled by any prior statements of the course to be adopted, made by any officer of the government.

5. When the contractor finds that the conditions are not as warranted in the contract he may abandon the contract. If he goes on he must notify the highest officer whose approval appears in or upon the contract, that he will claim additional compensation for more expensive work. Notice to the local officer in charge is not sufficient.

6. Only in clearly established cases of mutual mistake, will the contractor be released from the obligations imposed by the terms of a written contract.

(To be Continued.)

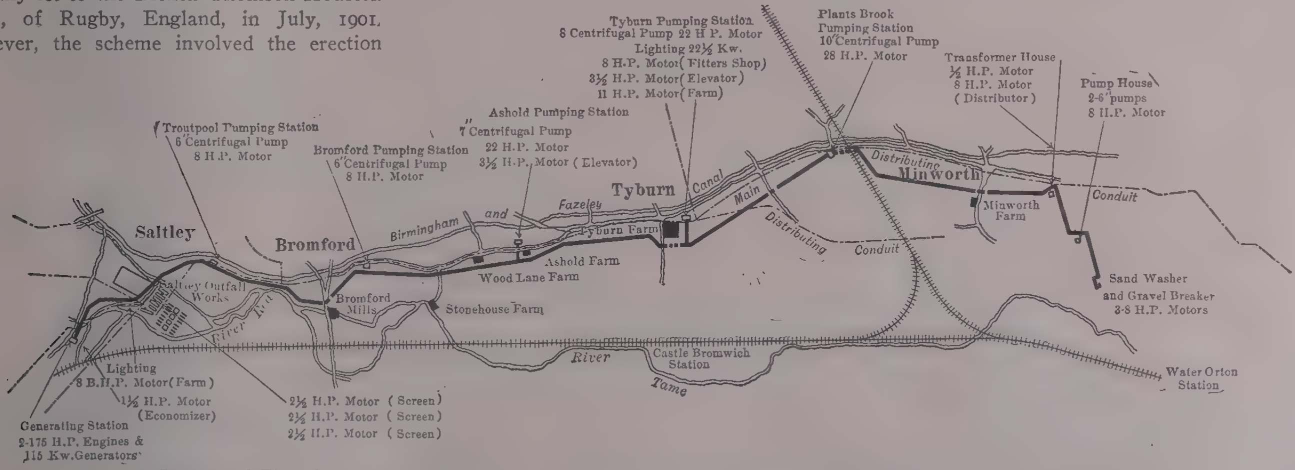
The Economic Depth of Trusses and the depth for maximum stiffness are discussed in the "Proceedings" of the American Philosophical Society, by Prof. Mansfield Merriman. The economic depth of a deep Pratt truss was obtained by forming an algebraic expression for the amount of material in the truss in terms of its dimensions, given loads and allowable unit stresses and then finding the value of the ratio of depth to panel length which renders that expression a minimum. To determine the depth that gives the greatest stiffness, an algebraic expression for the stored energy in the truss due to the deformation of its members was formed and this equated to the deflection due to the given loads. Then the values of the ratio of the depth to panel length that render this expression a minimum were deduced for different numbers of panels. The investigation shows that no additional stiffness can be imparted to a bridge by giving to the truss a depth greater than the economic depth.

Electric Sewage Pumping, Birmingham, Tame and Rea District.

Among the more recent developments of the use of electrical power is the installation of a complete electrical power transmission scheme extending from Birmingham (England) down the valley of the Tame for a distance of about six miles. The object of the scheme is to enable the Birmingham, Tame and Rea District Drainage Board, for which the work has been done, to pump sewage up to a strip of land adjacent to and situated at a higher level than the main conduit which conveys the sewage from the outfall works within the city of Birmingham to the sewage farm located in the Tame Valley and extending from Birmingham to Curdworth. The Drainage Board's estate comprises a total area of 2,830 acres, nearly 2,000 of which are used for irrigation, the remainder being land unsuitable for irrigation or land occupied by roads, streams, buildings, tanks, cottage gardens, etc.

Apart from pumping sewage the power transmission scheme is employed to drive motors at various places along the valley, to drive sewage screening rakes, sludge elevators, sewage distributors, workshop appliances, farmyard machinery, lighting, etc.

The contract for the entire undertaking was provisionally let to the British Thomson-Houston Co., Ltd., of Rugby, England, in July, 1901. As, however, the scheme involved the erection of a destructor by the city of Birmingham on land belonging to the Board, Parliamentary powers had to be obtained before the undertaking could be proceeded with, and, owing to various difficulties encountered, which delayed Parliamentary sanction, but which were not connected with or incident to the scheme itself, it was not until June 19, 1904, that the contract was finally confirmed and the work begun. The plant is now in full operation, and when the fact is taken into consideration that besides the destructor, a generating station and five brick pumping stations with provision for a sub-station in each, five miles of overhead line with crossings underground under public roads, together with the complete equipment of the generating station, sub-stations, and sundry machinery on different parts of the estate were involved, it will be apparent that no time has been lost in carrying out the undertaking.



System of Electric Power Transmission and Sewage Pumping of the Birmingham, Tame and Rea District.

The generating station is situated near the Saltley boundary of the Drainage Board's estate It contains two British Thomson-Houston 115-kw alternating-current generators, each of which is coupled to a high-speeed Belliss & Morcom engine. The generators are designed to give their output at 2,250 volts and 50 cycles, each generator being fitted with a direct-connected exciter so that the unit is self-contained. A small direct-current steam set of 15 kw., 220 volts, is also installed in this station. This latter set is used to operate a number of enclosed arc lamps on the sewage beds at Saltley, to light the station and, in case of necessity, to excite the alternating-current generators. The steam is supplied to the engines from Lancashire boilers combined with the destructor which is adjacent to the generating station.

The destructor, as before mentioned, was erected by the city of Birmingham, and steam is supplied to the Drainage Board under an arrangement with the authorities of the city of Birmingham Thus the cost of power required is reduced to a minimum by the utilization of material that would otherwise be valueless.

The destructor is lighted throughout from the generating station, and there are two alternative systems of lighting—one from the direct-current side, and one from the alternating system of supply from the main generators; in the latter case suitable transformers being provided in a transformer chamber under the generating station to reduce the pressure from the primary 2,250 volts to 220 volts, which is the pressure of the lighting circuits.

The main switchboard bus-bars are connected to the overhead line by means of three high-tension cables separately supported from the walls of the generating station by heavy porcelain insulators and led up to the outlet, which consists of three separate porcelain outlet tubes built into the wall. Through these tubes high-tension insulated cables are led, and connected outside on shackle insulators to the overhead line, which consists of hard-drawn copper of special high-tensile strength, supported throughout its entire length by high-tension insulators of the triple petticoat type. The section of the copper in the overhead line is so graded that a drop in pressure of only 7½ per cent. over the whole line is obtained at maximum load. Throughout the length of the overhead line a barbed wire is run on the top of the poles and earthed at frequent intervals for protection against lightning. In all cases where the overhead line enters or leaves a building lightning arresters of the alternating-current type have been installed.

For the underground road crossings a special form of steel terminal poles has been designed, on the top of which is fitted a dividing box into which the high-tension overhead wires are led and there connected to a three-core high-tension cable, which is led down the inside of the pole and brought out at the bottom into the connection box. The cable from this point is laid in solid bitumen to the steel terminal pole on the opposite side of the crossing, where it is connected through another dividing box to the high-tension line; it then proceeds overhead up to the next crossing The other poles are of creosoted wood and are set in concrete on account of the soft character of the soil in which they are planted, most of the land having been until comparatively recently, and in some cases still being, under irrigation.

From the generating station the line proceeds to the Drainage Board's Saltley farm. At Saltley the line is tapped and led into a sub-station which is a portion of the old farm buildings converted for the purpose.

This sub-station contains three 5-kw. transformers, which supply power to three 2 h.-p. motors driving sewage screens, and one 8 h.-p. motor driving farm machinery through a countershaft, and for lighting the offices and the works manager's house. The 2 h.-p. motors for driving the screens are 200-volt, 50-cycle machines, running at 1,420 r.p.m. and are connected to the screens through spur reduction gearing.

From Saltley the high-tension line proceeds towards Minworth to the Troutpool pumping station.

All the pumping stations are of artistic appearance, and do not in the least detract from the landscape. They were designed in the offices of the engineer to the board, as was also the generating station at Saltley. Each pumping station is divided into two rooms, one containing the pump motor, starting gear and high-tension switch gear and the other the transformers.

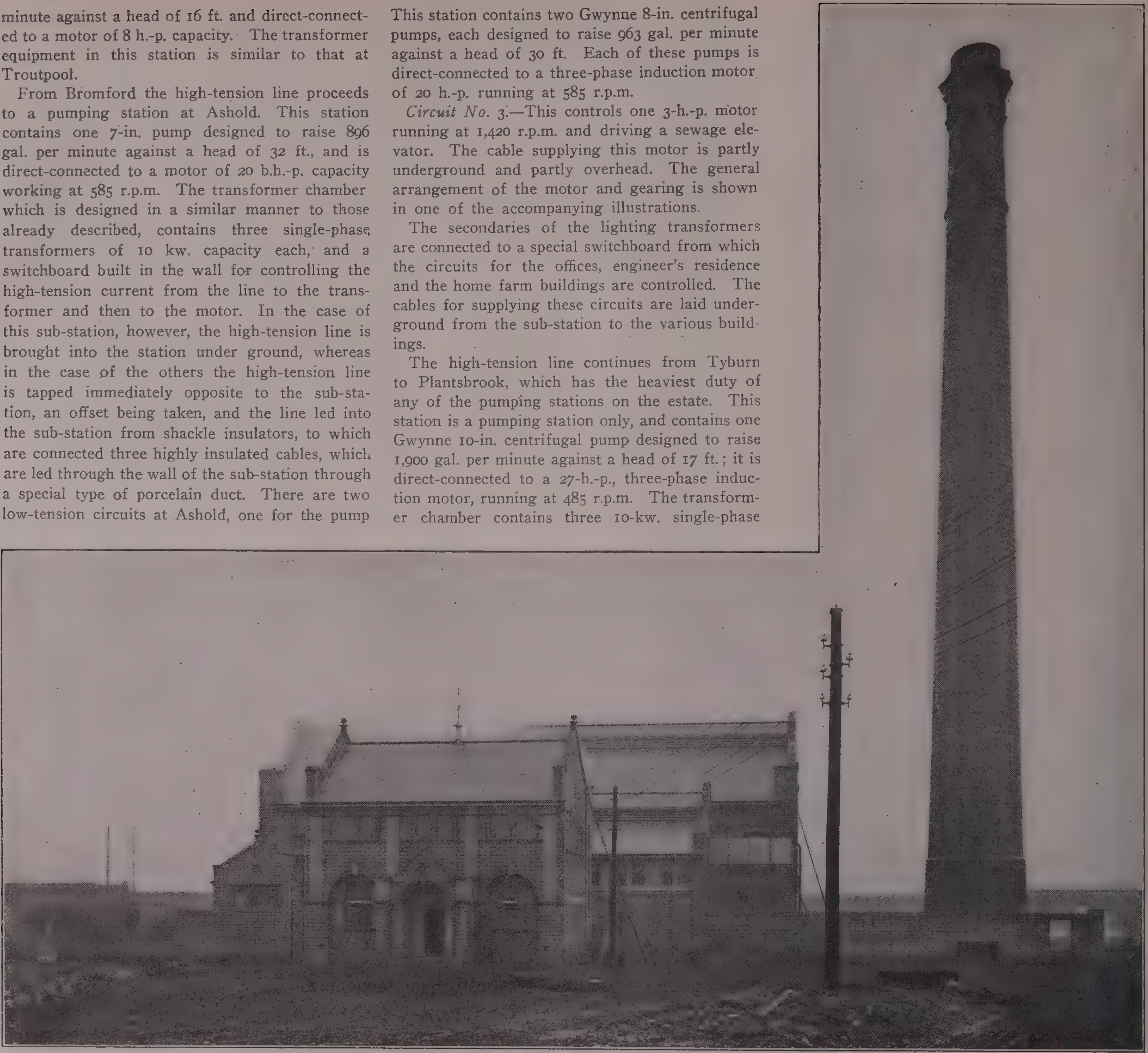
The Troutpool pumping station contains one 6-in. Gwynne centrifugal pump, designed to raise 696 gallons per minute against a head of 16 ft. It is direct-connected to a 6 h.-p. 960-r.p.m., three-phase motor. The starting arrangement for this motor is supported on brackets from the floor immediately adjacent to the motor, and the same plan is followed in all the other pumping stations.

The transformer chamber at Troutpool contains two 4-kw. single-phase transformers having a ratio of 2,200 to 200, and is divided from the pump-room by a brick partition, the door between being kept locked, and access to it only obtained by the authorized staff of the Board; thus the risk of accident, due to ignorance or carelessness is reduced to a minimum. Similar precautions are taken at all the other stations.

In all the pumping stations the cables connecting the transformers to the switchboard are run in special trenches, covered by chequered plates and are readily accessible. The back of the switch panel projects into the transformer chamber in such a manner that the switch panel itself really forms a portion of the dividing wall between the pump room and the transformer chamber. This ensures the most efficient and shortest length of cable connections possible between the transformers and the controlling gear. All the pumping and sub-stations are arranged in a similar manner, the only difference being in the number of circuits controlled from the sub-station to meet the requirements of the particular area supplied from it.

From Troutpool the line proceeds to a pumping station at Bromford which, like the Troutpool pumping station, is equipped with a Gwynne 6-in. centrifugal pump designed to raise 696 gal. per minute against a head of 16 ft. and direct-connected to a motor of 8 h.-p. capacity. The transformer equipment in this station is similar to that at Troutpool.

From Bromford the high-tension line proceeds to a pumping station at Ashold. This station contains one 7-in. pump designed to raise 896 gal. per minute against a head of 32 ft., and is direct-connected to a motor of 20 b.h.-p. capacity working at 585 r.p.m. The transformer chamber which is designed in a similar manner to those already described, contains three single-phase transformers of 10 kw. capacity each, and a switchboard built in the wall for controlling the high-tension current from the line to the transformer and then to the motor. In the case of this sub-station, however, the high-tension line is brought into the station under ground, whereas in the case of the others the high-tension line is tapped immediately opposite to the sub-station, an offset being taken, and the line led into the sub-station from shackle insulators, to which are connected three highly insulated cables, which are led through the wall of the sub-station through a special type of porcelain duct. There are two low-tension circuits at Ashold, one for the pump motor, and one for the 3 h.-p. motor driving an elevator similar to that at Tyburn.



Destructor and Main Generating Station of Electric Sewage Pumping System.

From this station the high-tension line proceeds direct to Tyburn, where the largest pumping and sub-station is situated. This station is also connected to the high-tension line by underground cable, and the transformer chamber contains three 15 kw. single-phase transformers and three 7½-kw. single-phase transformers, each being arranged for a ratio of 2,200 to 200 volts The 15-kw. transformers are for the power circuits, and the 7½-kw. transformers for the lighting circuits. They are all of the oil-cooled type.

At Tyburn the three power circuits are as follows:

Circuit No. 1.—This controls one motor of 8 h.-p. running at 960 r.p.m. and one 10 h.-p. motor running at 960 r.p.m. These motors are used for the operation of general farm machinery and for driving the mechanics' shop where the mechanical repairs required to the existing plant on the Board's estate are carried out, and any special tools required on the estate are made.

Circuit No. 2.—This controls the pumping station proper, which, as in the case of the other stations, is immediately adjacent to the transformer chamber and contained in the same building. This station contains two Gwynne 8-in. centrifugal pumps, each designed to raise 963 gal. per minute against a head of 30 ft. Each of these pumps is direct-connected to a three-phase induction motor of 20 h.-p. running at 585 r.p.m.

Circuit No. 3.—This controls one 3-h.-p. motor running at 1,420 r.p.m. and driving a sewage elevator. The cable supplying this motor is partly underground and partly overhead. The general arrangement of the motor and gearing is shown in one of the accompanying illustrations.

The secondaries of the lighting transformers are connected to a special switchboard from which the circuits for the offices, engineer's residence and the home farm buildings are controlled. The cables for supplying these circuits are laid underground from the sub-station to the various buildings.

The high-tension line continues from Tyburn to Plantsbrook, which has the heaviest duty of any of the pumping stations on the estate. This station is a pumping station only, and contains one Gwynne 10-in. centrifugal pump designed to raise 1,900 gal. per minute against a head of 17 ft.; it is direct-connected to a 27-h.-p., three-phase induction motor, running at 485 r.p.m. The transformer chamber contains three 10-kw. single-phase transformers having a ratio of 2,200 to 200 and the usual controlling switchboard.

Near this station the high-tension line is led into a conduit passing under the Midland Railway and thence to Minworth Greaves, where it terminates at present. The sub-station at Minworth Greaves is used for supplying power to operate two sewage distributors, which were previously operated mechanically, and which are used for distributing sewage over circular bacteria beds. This sub-station contains three transformers having a ratio of 2,200 to 200 volts and the necessary switchboard.

It is proposed to extend the high-tension line from this point one-half mile further towards Curdworth, where the Drainage Board is carrying out very extensive works in the building of bacteria beds, and where it is intended to electrically operate the gravel-washing machinery, consisting of a pump, stone crusher and winch.

It is also intended to extend the use of the electric power thus obtained by installing deep-well pumps 400 yd. from the Minworth Greaves terminus. These pumps will be supplied with current at a pressure of 200 volts direct from the same sub-station as the gravel washer.

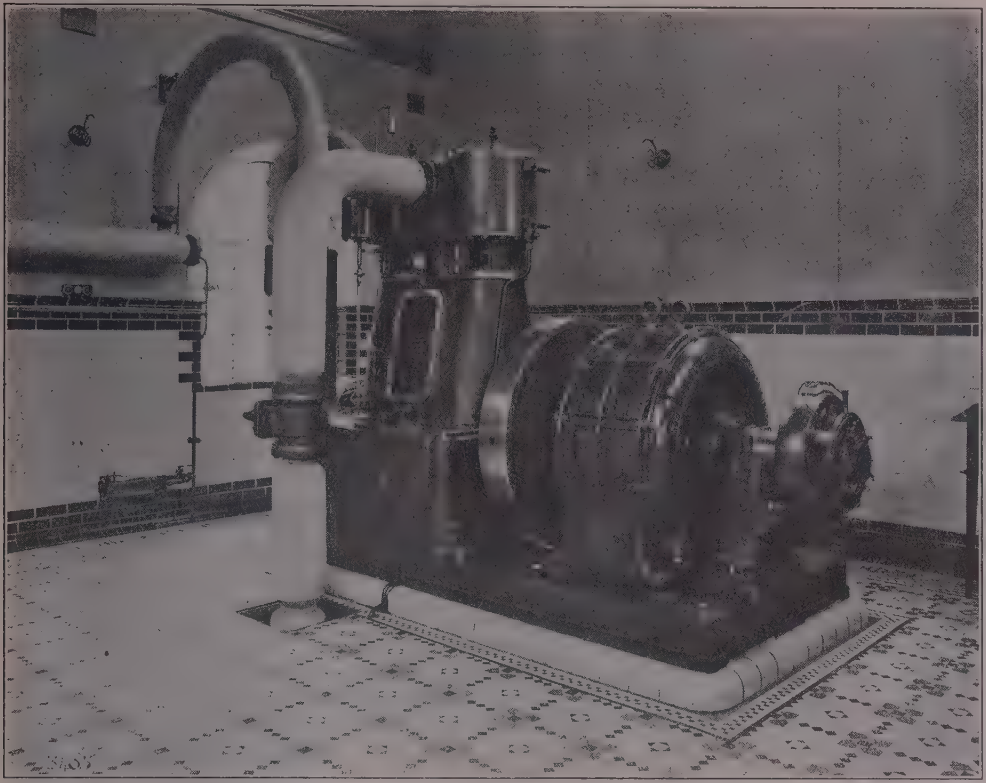
The undertaking of the Birmingham, Tame & Rea Drainage Board, embodying as it does all the features of a comprehensive high-tension power-distribution scheme, is one of the pioneer undertakings of its kind in Great Britain, and, in so far as the application of electricity to sewage disposal in the manner described is concerned, it is the first scheme of its kind in the world. Developments arising as a direct outcome of the undertaking will undoubtedly be watched with considerable interest by all those interested in the application of electrical power to the complex problem of sewage disposal, and other industrial purposes.

The inception of this sewage scheme is due to the initiative and enterprise of the engineer of the District Drainage Board, Mr. John D. Watson.

The Shifting Sands of Cape Cod are being held satisfactorily against the high winds of that location by growths of beach grass and plantations of pine, alder, bayberry and other trees and shrubs. The work was started several years ago by the State, and has been followed by private landowners, who have been impressed with the necessity of preventing the drifting of loose sand from the barren dunes over the tracts covered with vegetation.

Fire Drills in Factories.

In the course of the discussion at the recent meeting of the American Society of Mechanical Engineers on the reinforced concrete building of the Taylor-Wilson Manufacturing Co. (Eng. Record, Dec. 16), Mr. H. F. J. Porter pointed out that it will be many years before all factories will be fireproof, and meantime it becomes necessary to consider the best means for adoption to protect the lives and property housed in such factories as now exist and will continue to exist for a long time to come. The laws of the land and of the community in which a factory is situated require the fulfillment of certain obligations to insure such protection, but the moral responsibility which rests upon the employer of labor who assembles many people to work for him should require him to do many things for their protection which it is evident cannot be embodied in the law. And it is evidently to his interest that every consideration should be given to effect a prompt escape from the building in case of fire, for it is the first duty of a fire department to save lives before attempting to save property, and in a case where lives are in jeopardy attention must first be directed to their relief, and meantime much property may be destroyed.



View of 115-Kilowatt Unit, Showing Finish of Engine Room.

Mr. Porter's discussion supplemented, in a sense, Mr. Freeman's presidential address. He pointed out the necessity of arranging so that the means of promptly preserving lives are efficient so that as soon as possible after a fire starts escape from it may be effected and attention be given to putting it out. In this connection experience shows that there are more casualties resulting from panic occurring during fire than from the fire itself, and also that panic frequently occurs simply on the alarm of fire when actually no fire exists and on other occasions when there is a similar suggestion of danger. It therefore devolves upon the employer of labor to take such preliminary precautions that not only will his employes be able to obtain a prompt and easy exit from the building in case of fire but also be protected from the results of panic in such an emergency or of panic due to any cause whatever.

It would be well, Mr. Porter said, to consider the methods now in vogue for protecting the lives of employes in the ordinary factory of which there are hundreds in every large city of the country. In all of these places we find fire buckets, in many of them stand pipes with hose attached and in some of them sprinkler systems, but the factories so provided are few which have assigned to certain specified individuals the duty to use the buckets or the hose in case of fire or to turn off the sprinkler system after the fire is out; and what is anybody's is nobody's business, especially under stress of excitement. All of these appliances can, however, become effective by the development of a regular fire corps.

Electrically Operated Sewage Distributors at Minworth.

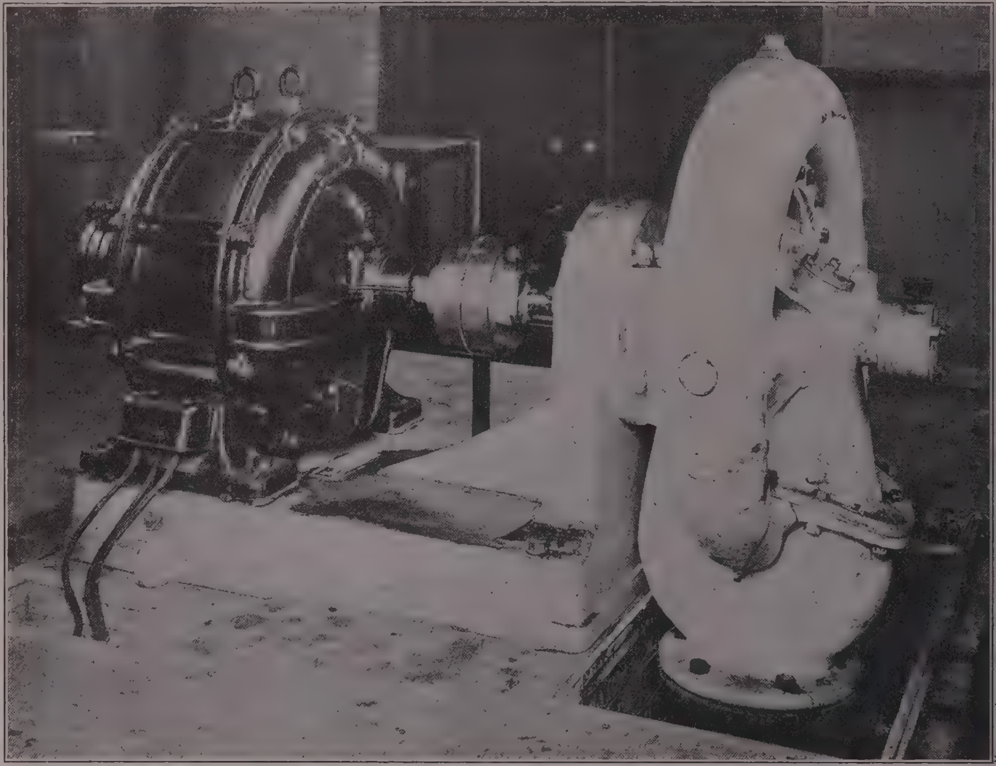
The fire escapes which are supplied to buildings generally are of such construction, according to Mr. Porter, as to be a more prolific source of than escape from accident. They generally consist of an iron balcony on the outside of the building at each floor and these balconies are connected by means of ladders, the lowest balcony having its ladder detached and hung up on the building so as to prevent people from entering the building, which they might if it was permanently placed on the ground. These ladders vary in position from the vertical to an angle of 50° or 60° with the horizontal and in order to descend people have to turn around and go down backwards. In all cases of emergency, when both women and men have to descend by such means, and especially in winter weather when the iron is cold and perhaps covered with snow or ice, these so-called escapes are prolific sources of accident, especially at the lowest balcony where, if the ladder is a long one, it is correspondingly heavy and the combined strength of several men is necessary to handle it. These men are not necessarily the first to reach the spot where it is located and they cannot well get there after others have crowded down ahead of them. There results on such occasions a jam accompanied by a crowding off of the balcony of those who are near the opening. Many of these escapes can be improved by making slight changes in them.

It has been stated that the mortality from factory fires is very low. It is doubtful, however, if there are reliable statistics to show the results of such casualties. After the announcement on the program of the meeting that there would be a discussion of this subject, Mr. Porter collected clippings from the press of several large cities on the subject of factory fires, and found that there are a number of casualties of this kind occurring every day, involving the lives of many employes. The latter are carried from the factory to their homes or to hospitals and their cases are subsequently lost sight of. The fire department of New York advised him that almost daily they have a fire in a factory where they have to save lives before they can direct their attention to extinguishing flames.

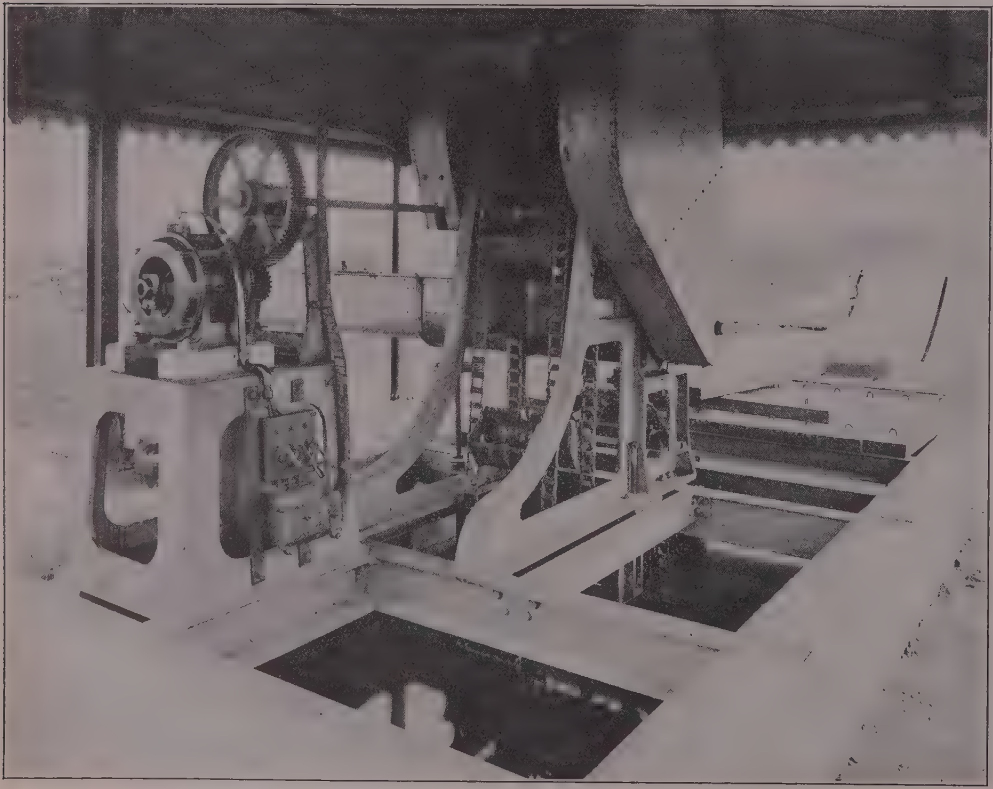
In a factory where Mr. Porter was engaged a couple of years ago, finding the conditions such that in case of a fire either within the building or in adjacent buildings it would be necessary to promptly empty the building of its occupants, he established a fire drill which, by occasional repetition, reduced the time of exit from more than seven to less than three minutes, a saving of time which, in the case of a rapidly burning fire or one involving considerable smoke, would undoubtedly have been the source of preserving many lives. Since that time he has introduced similar drills into other factories and in every case with remarkably desirable results. Whereas at first such a drill, owing to its association with danger, is usually accompanied by the fainting of some of the girl employes, later a habit of prompt and rapid dismissal is acquired and all become possessed with a feeling of security which largely counteracts the tendency towards a panic.

In a clothing factory employing nearly 1,000 hands, both men and women, on the occasion of an altercation between men in an adjoining railroad yard one of the employes called out "fight." Mistaking the call to be "fire," a panic occurred during which the factory was emptied with many accidents, one man leaping from a second-story fire escape and breaking his leg. Since the fire drill has been introduced there is no tendency towards a panic. Everyone knows there is no danger, at least until the fire signal is given, and that then they will be properly taken care of.

In another factory where 1,000 girls were engaged in making shirtwaists, the appearance of a rat occasioned a stampede which did not end until many girls were injured. There have been troduced, but the girls have gone quickly to the



Pumps Driven by Direct-Connected Induction Motor, Birmingham, Tame and Rea District.



Electrically Driven Sludge Elevator, Birmingham, Tame and Rea District.

similar occurrences since the drill has been in- nearest exit without excitement.

Some clippings which Mr. Porter brought to the meeting showed that panics occur where there is no danger. One from the New York "Times" mentioned in its headlines of fifty girls becoming hysterical and several fainting in a shirt factory where a newspaper blazed up from a spark from an electric motor and that many women were trodden down in a senseless panic by the men, who were the more terrified. Another clipping from the same paper spoke of the employes of a large manufacturing plant becoming frightened by the smoke entering the windows from a burning tar pot in the street and that in their rush for the exits a dozen were so injured as to require the attention of surgeons.

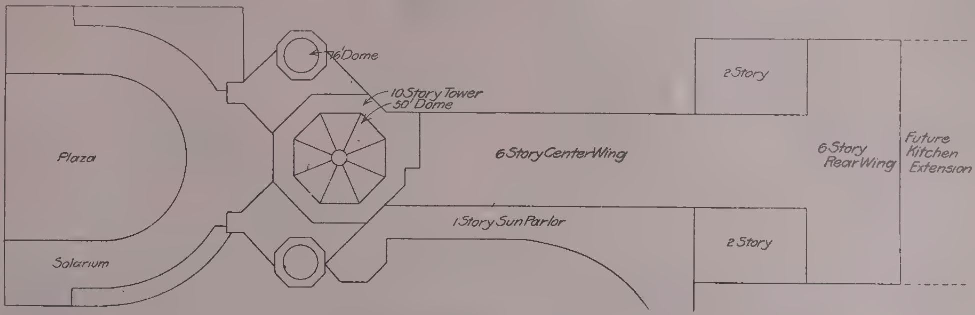
Other clippings showed that danger is occasioned by the carelessness of some of the employes themselves. The New York "Herald" of Nov. 11 mentioned 400 girls who were left locked in on the fifth story of a burning underwear factory by the watchmen, who went to the corner to send in the alarm, and that many leaped into nets held by the firemen and others were taken down on the fire ladders. Still another account told of a fire in a feather factory, where the girl employes went down the fire escapes until they reached the last balcony where they could not handle the heavy portable ladder and then on account of suffocation by smoke were carried fainting to the street.

Other clippings showed that fire drills have in similar instances saved lives. In a factory in Chicago, for instance, scores of employes on the signal of fire formed and marched from the building, which was shortly afterwards burned to the ground. An editorial from the New York "Sun" spoke of the efficiency of a fire drill in a hospital and a school, where large numbers of children were in danger of destruction by fire, but quietly marched from the buildings, whereas in two factories the adult employees were crazed with fright by an imaginary danger and injured each other and destroyed much property in their wild flight for safety.

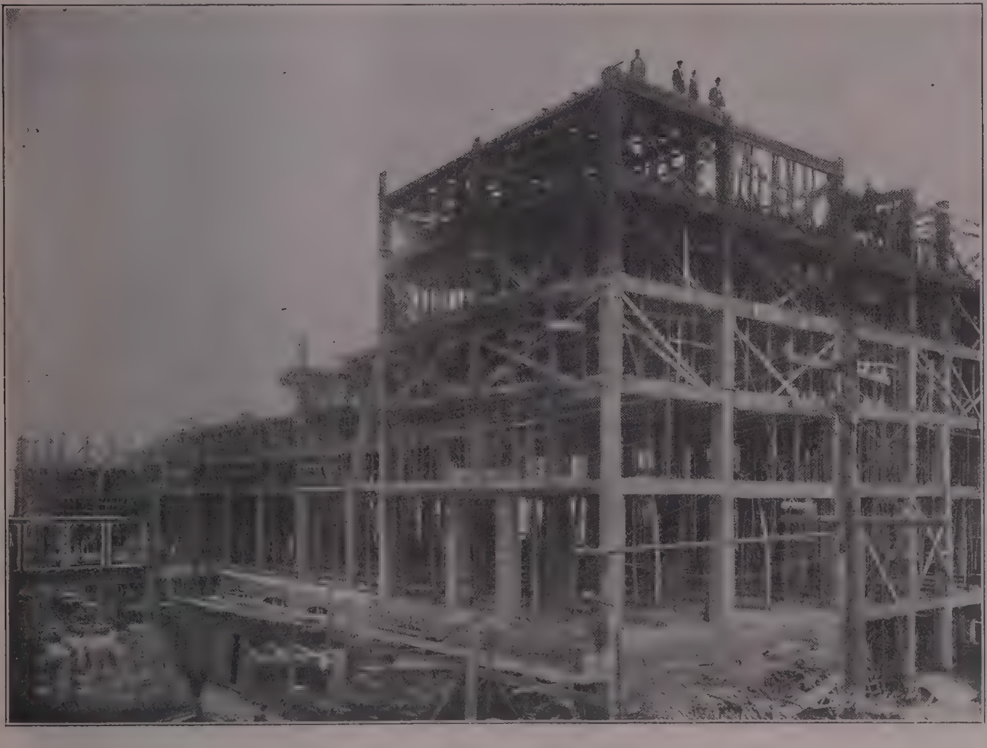
In many factories which Mr. Porter examined at the request of the proprietors to satisfy them that they were doing all they could for the safety of their employes he failed to find any which in one way or another had not introduced some obstruction to the availability of their fire escapes. Many factory owners give no thought to the subject after the fire escapes and fire buckets are supplied, and on one occasion the question to the superintendent, what he would do in case a fire occurred right then, was met by the amazing reply that he would think of some way to get his employes out. When pressed to think then, while he had plenty of time, of a way to do so, he was utterly unable to say how under conditions as they existed he would have gotten them out. It is only by going through the manœuvers which would occur in case of an actual fire that the efficiency of the appliances and escapes can be tested. A fire drill will do this and once introduced its desirability is too evident to allow it to be discontinued.

Reinforced Concrete and Tile Construction in an Atlantic City Hotel.—I.

The so-called annex of the Hotel Marlborough, Atlantic City, N. J., is in reality an independent 128x326-ft. eight and twelve-story fireproof building, 164 ft. in extreme height from grade to the top of the dome and 96 ft. high to the main roof. It is located adjacent and parallel to the original Marlborough Hotel, which is a building of about the same size but of another architectural style and wholly different construction. In plan the annex is symmetrical about its 326 ft. longitudinal axis and has wide front and rear portions connected by a 45x147-ft. center wing. The axis of the building is perpendicular to the shore line and the front wing, which is about 144 ft. above mean low tide or datum, extends to within 125 ft. of the famous Board Walk which is here at an elevation of about 14 ft. The front wing has eight sides, exclusive of the towers and corners, and is of elaborate exterior construction to give it an ornamental architectural effect. It is surmounted by a large central dome, flanked by two small domes and two tall chimneys. The lower part of the front wing will join the rear of the two-story solarium, a horseshoe-shaped structure enclosing an open court and extending to the Board Walk. At the rear of the building a large kitchen extension is now being built. This had not been included in the original contract and neither this nor the solarium are included in this description. The annex has a basement above grade, but no cellar; the lower two stories are devoted to public and operating purposes, and the upper six stories contain 250 guest rooms.



Plan of Hotel Marlborough, Atlantic City, N. J.



View of the Reinforced Concrete Frame of the Hotel.

At the sixth floor the plan of the ocean and center wings is as indicated by the general diagram, and the outer walls do not form any reentrant angles in the intersection of the two wings. At the seventh floor the outline of the plan begins to change and the walls of the ocean wing to be continued around the side next to the center wing so that the octagon is gradually completed and separated from the center wing and a tower is developed, which is carried up to the tenth floor and is there surmounted by an octagonal ribbed concrete dome with a radius of 25 ft. The inscribed diameter of the octagon is 64 ft. up to the ninth floor, where it is reduced to 54 ft.

At the eighth floor level the two small flanking octagonal towers are wholly detached from the main tower in the ocean wing, and up to the tenth floor they have a reduced diameter. They are surmounted by balconies with ornamental balustrades at the eighth floor and have ornamental curved radial buttresses reaching from the eighth to the tenth floors at the angles of the octagons.

In order that the annex might be built with great rapidity and with the minimum disturbance to the guests who occupied the adjacent hotel during its construction, it was built entirely of hollow tiles, made by the National Fireproofing Co., combined with reinforced concrete and terra cotta without any structural steel, brick, or timber work. This type of construction secured fireproof qualities and durability at a cost not greater than the estimate for ordinary steel skeleton construction, and at the same time avoided the very objectionable noise of riveting which would have been a serious disadvantage so close to the sleeping-rooms of summer guests. There is not a pound of structural steel work in the main framework of the building and therefore the delay usually inevitable in securing riveted work, beams and girders from the mills and shops was escaped and the standard materials required for the tile and concrete work were obtained promptly and used by comparatively unskilled labor, which was easily secured and controlled. It resulted that novel features were introduced in the design, that the tiles, some of them made specially for floor construction, were combined on a large scale with special details, and that the work was executed with great rapidity and with a minimum of features objectionable to the neighboring residents.

Fireproof hollow tiles were used exclusively for all but the ornamental portions of the exterior walls and for the special reinforced floor construction; concrete materials were readily available in large quantities, and as much of the steel reinforcement was taken from stock more easily secured than structural steel, the principal materials were all available without delay and were of a character that could be rapidly used by ordinary workmen under competent direction, so that the work was done in an unusually rapid and satisfactory manner.

The floor construction which was the most important feature of the design, consisted essentially of reinforced concrete girders carrying numerous comparatively shallow transverse reinforced concrete floor beams. These were so close together that their economical depth was within the limiting thickness of the floor slab and the spaces between them were filled with hollow tiles that weighed much less than solid concrete of the same thickness, were rapidly placed, did not require as long to set as would massive concrete slabs, and had the advantages of air spaces. Additional stiffness was secured by the increased depth and the slabs were more sound proof than ordinary concrete construction.

Care was taken in the design of the beams and girders to provide for both horizontal and vertical tensile and shearing stresses by rolled steel bars with the inclined members integral with the main horizontal body of the bar. About 132,680 cu. ft. of hollow tiles were used in the building and had an average weight of 40 lb. per foot. Assuming the weight of concrete at 150 lb. per cubic foot the saving in weight over an equal thickness of concrete is about 14,594,000 lb., a very important consideration in length of span and dimensions of girders and columns. All tiles were 12 in. square and were 3, 4, 6, 8, 10 and 12 in. thick with corresponding cross-sectional areas of 22.5, 25.5, 31.5, 37.5, 44.5 and 49 sq. in. respectively. All the floor tiles were laid by one bricklayer and helper. Tests made on specimens of the tiles showed ultimate crushing strength of 4,600 per square inch on small cubes.

There is no general excavation under the building, the original surface of the ground being in most cases simply levelled to receive the basement floor between the foundation piers. At the ocean end the first or lobby floor is at the level of the Board Walk, but farther back it descends about 3 ft. On this floor are the main entrance, hotel office, lobby, public toilet rooms, barber shop, cafe, and in the rear wing a 100x118-ft. unfinished machinery room, all the space underneath being utilized for basement storage and miscellaneous purposes. On the next or exchange floor the large 76x128-ft. exchange, or rotunda, occupies the whole of the polygonal front wing and communicates with the ballroom in the solarium at the same level which extends to the Board Walk. The ballroom is two stories high and is surmounted by a small-rise concrete dome 40 ft. in diameter. Beyond the exchange a corridor leads through the center of the building to the rear end, dividing that wing into two large rooms one of which is used for the dining-room and the other for a banquet-room. On each side of the corridor in the middle part of the building are arranged offices, telephone exchange, private parlors and dining-rooms, ladies' parlor, etc., and on one side there is a wide covered corridor with glass front, which serves as a sun parlor. The upper floors are arranged as guest rooms, singly and en suite.

The substructure of the building consists of 159 rectangular piers and the footings of the outer wall, the latter being built of granite ashlar up to the water table of the exchange floor. The pier footings are of reinforced concrete, most of them about 7 ft. square at the base and supported on nine or ten piles. The piers supporting the columns under the main dome have twelve piles each, and some of those having smaller loads have only five piles each. In all there are about 1,800 piles averaging 20 ft. in length and 8 in. in diameter at the butt. They are loaded 15 tons each and were driven in the coarse clean sand at the rate of as many as 200 in ten hours with an hydraulic jet and a few blows of a hand hammer operated by two men. The least distance from the piles in the front wing to the shore line was 150 ft., and as the flow of ground water near the surface was not very rapid the excavations were made quickly around the pile tops and the water was kept out with hand pumps until the piles were cut off with hand saws at a level of + 5.5. The excavation was carried 12 in. below the cut off and in it was quickly placed a 27-in. layer of 1:2½:5 concrete made with ¾-in. broken stone. In this were bedded reinforcement bars 2 in. above the pile tops. The principal footings contain also four ¾x2-in. vertical bars 3½ ft. long which project upwards to form dowels to bond the pier and column together. The piers have a 12-in. upper course, integral with the lower course, with a 12x12x12-in. central pit in the upper surface to receive the column foot. The wall piers are connected by reinforced concrete beams 4 ft. below the surface of the ground, to carry the lower story of the wall. For a clear span of 17 ft., as shown for piers 6 and 7, this beam is 22 in. wide and 12 in. deep and is reinforced by three ¾x2-in. bars 18 ft. long in the lower flange, and by two inverted bars of the same size, 9½ ft. long in the top flange.

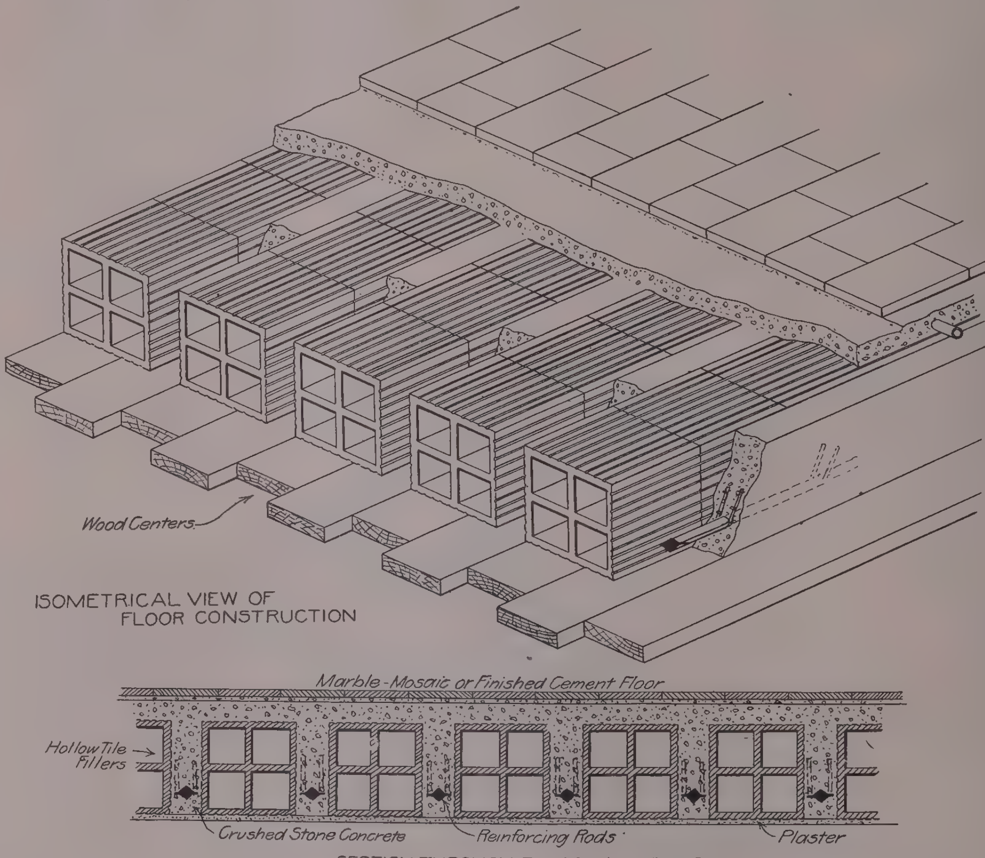
The lobby and exchange floors are proportioned for live loads of 75 lb. per square foot, all other floors for 50 lb., and the roof for 30 lb. Full-size floor tiles have developed under tests, an ultimate crushing strength, sideways, of 2,020 lb. per square inch and 4,004 lb. per square inch endways, on the webs. In designing the floor, the computations for strength were made without considering the strength of the tiles and the concrete and steel were calculated to resist all stresses, the tiles being considered as fillers. The tiles were so laid, however, that they must develop considerable arch action before the floor could fail and thus materially increase its strength at the same time that their hollow spaces diminish the dead load very advantageously and promoted rapidity of construction.

The strength of the concrete is taken at 2,400 lb., and it is proportioned for unit stresses of 500 lb. and 750 lb. per square inch for live and dead load and for wind stresses respectively. The Kahn bars, which are used exclusively for all reinforcement, are calculated for maximum unit stresses of 16,000 lb., combined dead and live loads, and for 20,000 lb. wind load.

The walls and floors are carried by reinforced concrete columns, which, except under the main dome are generally about 17 ft. apart in rows parallel with the sides of the building. They have rectangular cross-sections increasing downwards from 12 in. square in the attic to 24 in. square in the basement. The maximum regular column load is 296,000 lb., and is resisted by 576 sq. in. of concrete and 8 sq. in. of reinforcement bars. The wall columns are the same size as the interior columns. The columns are made integral with the floor slabs and girders and their tops are in the floor planes above which the vertical reinforcement bars extend about 30 in. to bond the adjacent column sections together. The eight columns supporting the dome have maximum loads of 353,000 lb. in their lower sections, and are of special construction. They are 24 in. in diameter and are reinforced by four vertical 1-in. bars and are hooped, in the lower two stories, with No. 8 B. & S. gauge steel wire tightly wound at a 3-in. pitch around the column and wired at intersections to the vertical bars. The vertical and spiral steel reinforcement was fastened in position and placed in the moulds with an overlap of 1 ft. at the joints between upper and lower sections of the columns, at the first and second floors. The hooped columns were designed for a unit stress of 850 lb.

Architectural considerations determined the positions of the partitions, usually 18 in. eccentric from the columns, and required that there should be no projections below the ceiling except the wind struts at every second row of columns. Intermediate floor beams were therefore not permissible and the floor panels were made with unusually long spans. There are no transverse beams except the wind struts about 33½ ft. apart, and the columns are connected by 10x16-in. longitudinal girders reinforced by two 3x1-in. and one 2¼x¾-in. bars. A ¾-in. horizontal bar 6 ft. long is bedded in the floor slab crossing the top of each column and engaging both adjacent girders to bond them together and transmit lateral stresses and to provide for the negative bending moment there, but their effect was not computed or allowed for in securing continuity of girders.

The average span of regular floor panels is about 18 ft. on centers of columns with a maximum of 25 ft., and the floor slabs are made with 6-in. hollow tiles 12 in. wide, set close together in rows transverse to the floor girders and 16 in. apart on centers. The 4-in. spaces between the rows are filled with concrete integral with a 2-in. layer on top of the tiles and containing reinforcing bars which practically make transverse joist. In the short-span corridor floors the slab is made with 3-in. tiles and the reinforcement bars are in the same lines as those of the adjacent long-span panels and are connected to them by ½-in. inverted Kahn bars 6 ft. long and 32 in. apart, which cross the longitudinal girders.



ISOMETRICAL VIEW OF FLOOR CONSTRUCTION

SECTION THROUGH FLOOR CONSTRUCTION

Special Floor Construction in all Stories.

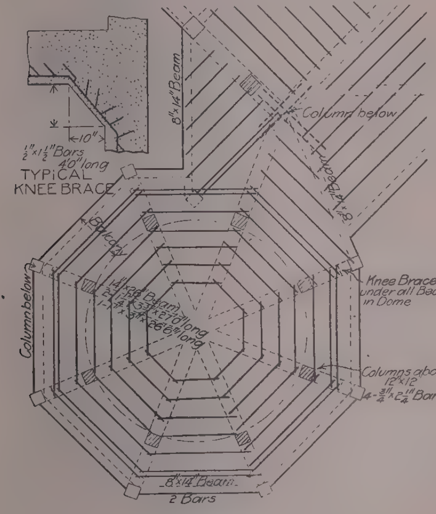
Under the main dome eight 24-in. circular columns are arranged about equidistantly in the circumference of a 32-ft. circle and in the two lowest stories the floor between them consists of a solid slab of reinforced concrete 8 in. thick with no beams or girders except those connecting the columns circumferentially. It is reinforced by two layers of crossed ½-in. bars from 6 in. apart at the center to 12 in. at the edges. This slab is bonded with the floor slabs in adjacent panels by inverted ½x1½-in. bars 8 ft. long and 32 in. apart, which extend across the tops of the circumferential girders and engage the slabs on both sides. It was built with 1-in. camber and showed no deflection under dead load when the falsework was removed. In all other stories this octagonal slab is made of the regular construction with 3-in. and 4-in. tiles covered with 2 in. of concrete and reinforced by bars 16 in. apart on centers in the concreted spaces between the rows of tiles. It is carried by 12x20-in. girders at right angles to each other 13 ft. apart extending across it from column to column and each reinforced by two 1¼x3¾-in.

bars 32½ ft. long, and by one ¾x2-in. bar 15 ft. long.

The reinforcement used throughout for floor slabs and girders consists of ½-in., ¾-in., 1-in. and 1¼-in. square bars rolled with flanges projecting from the diagonally opposite corners to form, where sheared away and bent up, the web members of the reinforcement trussing. The effective areas of these bars are respectively 0.38, 0.76, 1.42 and 2.00 sq. in.

In the guest rooms the floor slabs are covered with 2 in. of cinder concrete in which gas, water and electric light conduit pipes are bedded; over this is a 1-in. finishing coat of cement concrete and the angles with the walls all have rounded fillets so as to leave no place for the accumulation of dirt. The two lower floors are covered with 2 in. of cinder concrete in which nailing strips are bedded to receive the double layer of matched boards.

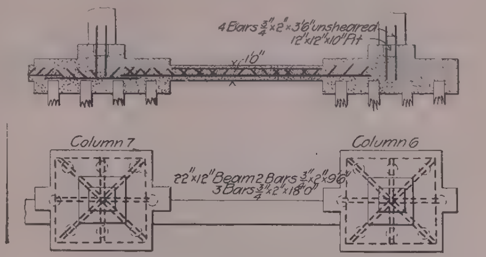
Up to the tenth floor the wall and columns under the main dome are continuations of the regular interior columns which extend in straight lines to the foundation piers of the building and the floors are carried by them and by eight interior columns symmetrically spaced on a 32-ft. circle concentric with the dome and outer walls and supported on the intersecting girders previously mentioned in the sixth floor. The eight interior columns extend, about 12 in. square, 18 ft. above the tenth floor, where their tops support the upper part, 32 ft. in diameter, of the octagonal dome. The tops of the columns are connected by horizontal girders forming an octagonal framework which is considered as the springing line of the arches formed by the dome segments.


8"x14" Beam
Column below
½"x1½" Bars 4'0" long
TYPICAL KNEE BRACE
10"
Balcony
14"x26" Beam 2-1"x3" x 27'0" long 1-¾"x3" x 26'6" long
Knee Braces under all Beams in Dome
Column below
Columns above 12"x12 4-¾"x2¼" Bars
8"x14" Beam
8"x14" Beam 2 Bars

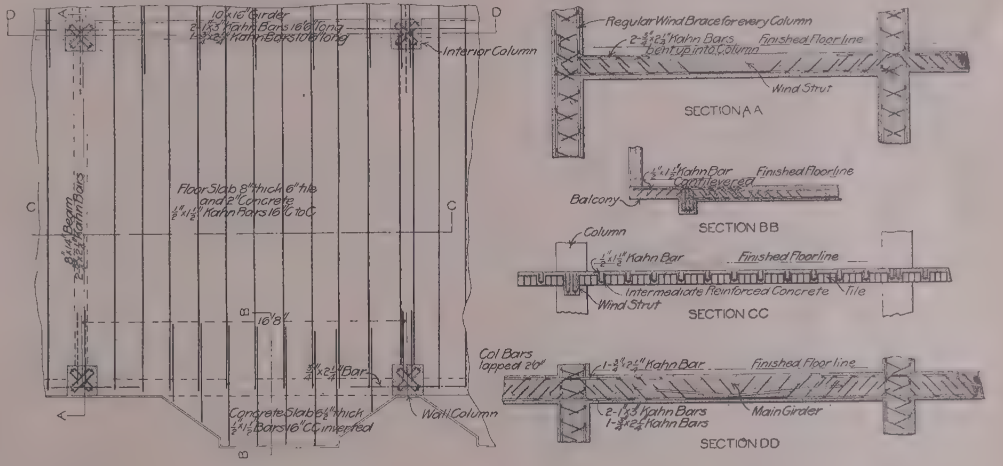
Floor in Corner Tower.

The dome shell is made of cinder concrete 5 in. thick reinforced by radial and circumferential rod bars 1 in. clear of the inner surface. It is stiffened by radial ribs intersecting the tops of the columns and continued to the tenth floor which with the curved concrete slabs uniting them, and forming the lower part of the dome, are considered to act, between the column tops and the tenth floor, as buttresses bracing the skewbacks at the column tops. The dome is surmounted by a cinder concrete lantern with 6 ft. vertical cylindrical walls and a hemispherical solid concrete roof 14 ft. in diameter. The radial ribs project beyond both inner and outer surfaces of the dome and on the outside are ornamented and continued to the lantern roof.

The tops of the buttresses and adjacent columns under the flanking domes are connected 21½ ft. below the eighth floor by a circular 13½x14-in. reinforced beam girder with an inside radius of 7 ft. 10½ in. On this girder is seated the hemispherical dome with an inner radius of 8 ft. and a thickness of 6 in. of 1:2½:5 hard anthracite cinder concrete. It is not stiffened by ribs, but is reinforced as shown in the half section by radial and horizontal curved bars. The eighth floors in the flanking towers are continuous with the main floor of the center tower and are supported wholly by the wall columns, indicated by hatched areas in the plan. These columns like all the others in the building have solid concrete knee braces reinforced with bent bars continuous into both column and floor as shown in the detail section. They support eight radial 14x26-in. girders with their upper surfaces flush with the eighth floor. These girders have no support at their intersection and carry the upper sections of the tower columns 4 ft. on centers from the lower columns. The tops of the outer columns are connected by 8x14-in. circumferential girders which with the radial girders support the continuous floor slab 4 in. thick reinforced with ½-in. bars 16 in. apart, parallel to the sides of the octagon.



Wall Girders and Pier Footings.


D
10"x16" Girder
2-1"x3" Kahn Bars 16'6" long
1-¾"x2¼" Kahn Bars 10'6" long
D
Interior Column
A
C
8"x14" Beam 2-¾"x2¼" Kahn Bars
Floor Slab 8" thick 6" tile and 2" Concrete ½"x1½" Kahn Bars 16" C to C
C
B
16'8"
¾"x2¼" Bar
Wall Column
Concrete Slab 6½" thick ½"x1½" Bars 16" C C inverted
A
B
Regular Wind Brace for every Column
2-¾"x2¼" Kahn Bars bent up into Column
Finished Floor line
Wind Strut
SECTION A A
½"x1½" Kahn Bar Cantilevered
Finished Floor line
Balcony
SECTION BB
Column
½"x1½" Kahn Bar
Finished Floor line
Intermediate Reinforced Concrete
Tile
Wind Strut
SECTION CC
Col Bars lapped 2'0"
1-¾"x2¼" Kahn Bar
Finished Floor line
2-1"x3" Kahn Bars
1-¾"x2¼" Kahn Bars
Main Girder
SECTION DD

Typical Floor of Hollow Tiles and Concrete Beams and Girders.

(To be Continued.)

A Long Island Single-Phase Railway.

A single-phase railway of unusual interest has recently been put in operation by the Long Island R. R. between Sea Cliff, Glen Cove and neighboring steamboat landings on Long Island Sound. It is only about 5 miles long, and was originally operated by direct current from a local electric company. It was ascertained, however, that power could be obtained more advantageously from the company's generating station at Long Island City (Eng. Rec., Nov. 4), about 27 miles distant, and used by single-phase motors. The transmission line consists of two No. 1 bare copper wires and the tension of the current is 11,000 volts. At Glen Cove there are two transformers reducing the tension to 2,200 volts. The trolley wire is of grooved cross-section equivalent to a 000 B. & S. wire, and is supported from a 7/16-in. steel catenary cable. There are four cars, each equipped with two 50-h.-p. Westinghouse motors, operated permanently in parallel and subjected to potential control.

On the Safeguarding of Lives in Theaters.—II.

Abridged from the Presidential Address before the American Society of Mechanical Engineers by Mr. John R. Freeman.

The Austrian Experiments.—Following the great theater fire in Vienna, a committee of the Austrian Society of Engineers built a model of the Ring Theatre on one-tenth of its lineal scale, which thus contained only 1/1,000 of the cubic contents of the original, and made many tests and experiments.

The experiments were divided into two groups, the first comprising those in which no ventilators were opened over the stage, while in each of the experiments of the second group, two ventilators were opened, having a combined area which according to the scale of their drawing was very nearly one-tenth of the area of the stage. In the first series of tests made by igniting sheets of paper hung to represent the scenery, but containing proportionally far less combustible material than is often hung on a theater stage, they found that the expansion of the air caused by the heat quickly forced the curtain outward from the proscenium arch, and within about twenty seconds from lighting the fire, this heating of the air produced an excess of atmospheric pressure, much greater than that of the ordinary pressure of city gas, thereby explaining why it was that the lights in the Ring Theatre became so quickly extinguished after the outburst of the fire.

In the second series of these Austrian experiments, their models of the ventilating shafts were closed by sheets of paper, and as soon as these burned open, all excess of air pressure disappeared from the auditorium, and indeed, the updraft drew the proscenium curtain inward over the stage. During these experiments, an unexpected warning was given against covering smoke vents by wire screens, for it was found the flying bits of charred paper carried up by the draft, almost completely closed them. To show how little this warning of the Austrian Society of Engineers has become incorporated in current practice, I may call attention to the building law of New York City, which requires that underneath all of these skylight openings designed as smoke vents, wire netting must be stretched; the law apparently never considering how quickly this will become so clogged as to destroy in large part the utility of the smoke vent.

The Committee of the Austrian Society of Engineers concluded that the outburst of flame and smoke into the upper part of the auditorium and the extinguishment of gas lights in a theater could all be prevented by providing adequate smoke vents over the stage, and places these smoke vents as the feature of first import in safeguarding life in theatres, and says that without them, emergency exits and fire curtains will be of no avail, and in this conclusion, I most heartily concur.

Regarding the mechanical construction of these smoke vents, the Committee says, "it is necessary that these be opened instantly upon the outbreak of the fire; mechanical contrivances of iron to be operated by human means will certainly fail, for according to all experiences in theater fires thus far, fright on the part of the employees prevents the use of such arrangements. They warned against automatic contrivances whose action may be interfered with in consequence of rust or expansion by heat and against sheet iron valves falling inward by their own weight, which might be restrained from falling open by the excess of pressure due to updraft, and finally, recommended that these shafts be closed by a quickly combustible tissue of hemp or jute covered with varnish or celluloid and with a hole about one and one-half inches in diameter in the center to invite quicker ignition. Our Austrian friends were unfamiliar with the American fusible-solder link, which is certainly quicker and safer and more practical than any such tissue of varnished hemp.

Fusible Links.—It is strange almost beyond belief how slowly and scantily fusible links have found their way into use on automatic fire shutters in theaters, although they have been so used in factories for nearly twenty years. These links melt open at about 162° Fahr., and thus will open long before flame reaches them. Their cost is trifling. All of the known solders that fuse at low temperature are subject to stretching or "cold flow" under long continued loads, unless these loads are made extremely small, and one of the most important features in the design of any such link is to make the direct stress upon the solder small and in tension over a large area, rather than by shear.

The sensitiveness of the link or quickness of action under moderate degrees of heat depends on the thinness of the mass of metal to be warmed up, and therefore on the rapidity with which it absorbs heat enough to melt the solder. These two characteristics, the weakness of the fusible solder under long continued strain and the necessity for rapid absorption of heat, limit the strength of fusible link that can be employed. In many situations, a link is desired of such form and size that when inserted in a rope, it can run over the ordinary pulley.

Smoke Vent Design.—The fundamental requirements are as follows:

First, absolute certainly of opening by force of gravity, in spite of neglect, rust, dirt, frost, snow or expansion by heat, twisting or warping of the framework.

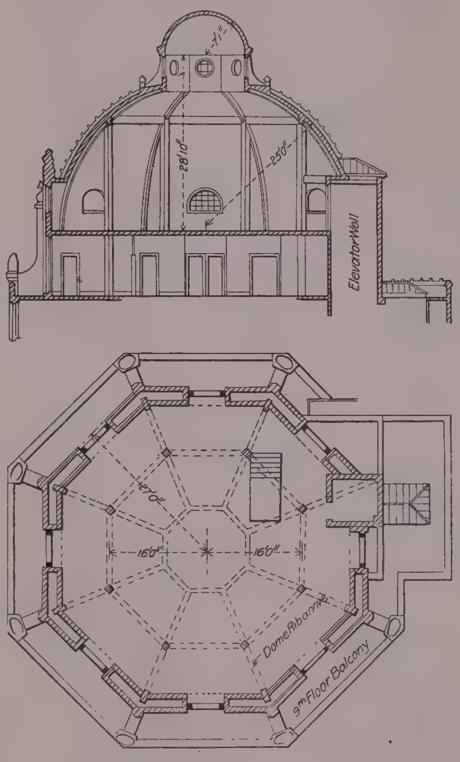
Second, quickness of opening to be secured by automatic links of the thinnest metal practicable and also by controlling the doors by a cord run down to the prompter's stand and to the station of the stage fireguard.

Third, the operative mechanism of the smoke vent should be simple and massive, designed according to the standards of railroad service or rolling mill practice. The counterweights should be heavy and a constant tension on the release cord of upward of 25 lb., so that rust, cobwebs or temperature changes might not be of noticeable effect in the resistance to be overcome.

Fourth, it should be of such form that it can be tested daily or at least at the weekly inspection by partially opening it, preferably closing it again by means of the cord running to the prompter's stand.

In the first of these designs, the 8x12-ft. opening, of which four would be needed over a stage of ordinary size, has a roof for protection from rain and vertical sides that contain four small windows for admitting daylight to the rigging loft, but which can be closed by ordinary window shades for dark scenes. All necessity for the wire screen is avoided. The four shutters fall outward lest the pressure of the updraft tend to hold them shut, and are pulled open by force of gravity, opening to the full area called for. The pull on the rope holds them against their seat, which, if made with a thin edge pressing loosely against fibrous material, as shown, will be more tight against cold air drafts than a common window sash or house door. Fusible links are inserted in each of the four branches of the cord. No sprinkler should be placed up within the monitor containing these links, and care should be taken that the links are of a thin, quickly sensitive type.

In the second design the sliding type is used. This obviously cannot be used as an ordinary ventilator in rainy days. The special effort in remodelling this from the current New York type has been, first, to place the glass in the vertical side so that no necessity for a wire screen remains; second, to provide a better track and trucks and arrange the joints so that the leakage of air through the clearance space would not tempt the janitor to close the space by something that may interfere with the sliding open.



Main Dome, Hotel Marlborough

A third sketch shows an arrangement of a safety ventilating shutter that sometimes can be conveniently placed in the brick wall near the top of the rigging loft.

Automatic Sprinklers.—The second safeguard in order of importance is, in my opinion, the complete equipment with automatic sprinklers over the stage and throughout all rooms and nooks and corners except in the auditorium. It is now nearly 25 years since Col. Thos. J. Borden, of Fall River, introduced automatic sprinklers in two Fall River cotton mills under his charge throughout picker rooms, card rooms and spinning rooms. These were put in by Mr. Frederick Grinnell, to whom more than any other man credit should go for the development of this great safeguard. Since that time, the factory insurance companies have been led by experience to urge automatic sprinkler protection as the foremost of all safeguards against fire. We have records of more than a thousand factory fires that have occurred under sprinkler protection, covering a great variety of conditions, and from my own experience in what sprinklers can do to control a fire under adverse circumstances, I unhesitatingly recommend them as the best of all known means for promptly controlling a fire that has once got hold in the scenery upon the stage of the theater.

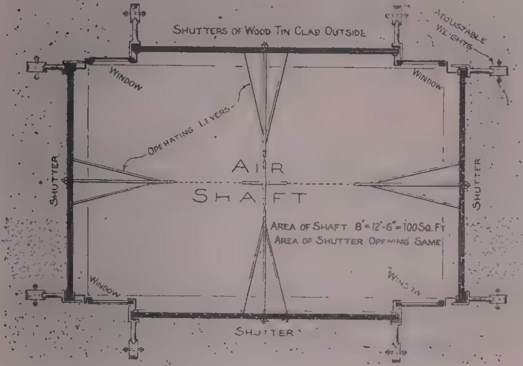
It has been claimed that under the high rigging loft of a theater, sprinklers at a distance of 60 or perhaps 80 ft. above the floor of the stage would be so remote from the flames that they would not open with sufficient promptness to be of material service. I am confident that this is untrue. The hot air from a fire quickly travels over a vertical distance of 60 or 80 ft. Not more than five to ten seconds' time would be required for this, and the conditions for pocketing and confining the heat to a small area in the top of the rigging loft of a theater are much more favorable than in many portions of factories where sprinklers are found to work successfully. The rainfall from a series of automatic sprinklers carries tenfold more water than that from densest 10 minutes of the heaviest thunder shower of the ordinary year; with 80 sq. ft. to the sprinkler and ordinary water pressure the rainfall would be about 25 in. per hour. One series should be placed below the gridiron and preferably another series above it, these not being vertically over one another. Those in the top series are likely to open first, but it is well to be liberal and provide both series. A line should also run along the lower outer edge of each fly gallery. With care a skilful sprinkler fitter can readily place and guard all the heads and pipes so the danger of breakage need be no greater than in a factory. The 162° solder should be used.

The fact that there are so few actual records of what sprinklers can do in controlling a fire on the stage is due to the few instances where sprinklers have been installed in theaters, or have had an opportunity to demonstrate the work of which they are capable. At least there have been no failures, and we have one notable success to their credit, and this is a case where they had been put into a theater because a factory manager who was one of the stockholders had been satisfied of their efficiency by fires that they had extinguished in his cotton mill. This was at a theater in Woonsocket, R. I., in which a gauze piece took fire from the border lights prior to the performance and sprinklers opened under the gridiron 65 ft. above the floor while other sprinklers opened under the roof 80 ft. from the floor. At theaters in Philadelphia, New York City and Providence, R. I., there have been notable instances of fires when the audience was absent from spontaneous combustion and overturned lamps where the sprinkler extinguished the flames and from Manchester, England, a case is reported of a fire in a "gauze sky," between the acts, extinguished by four sprinklers 30 ft. above the flies, so promptly that, although the stage and scenery were wet, the performance went on without the audience knowing just what had been going on while the curtain was down.

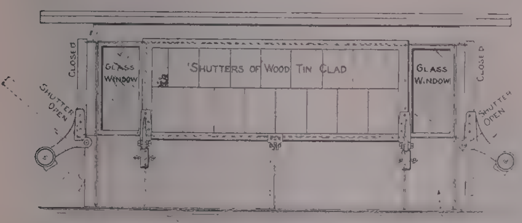
Possibility of Leakage.—A leading argument against automatic sprinklers has been the possibility that they would break open when there was no fire and thus injure the scenery. We have statistics to show how extremely small this danger really is.

The records when last compiled showed that out of a total of something over three million sprinkler heads scattered through more than two thousand different factories, losses from premature discharge were occurring at the rate of about fifty sprinkler heads breaking open per year. This proportion of one sprinkler in each sixty thousand springing a leak per year, when applied to the conditions in a theater that would commonly have less than one hundred and fifty sprinkler heads over the stage, although they were put in both under and over the gridiron and under the fly galleries, would give a probability at any one particular theater of a leak once in four hundred years. Should we admit, which is not certain, that the danger of knocking one of these sprinklers open by a blow is greater in the theater than in the factory with its moving machinery, it is plain that this danger of leakage is no just ground for excluding sprinklers from over a theater stage. Our insurance companies do not hesitate to recommend them for a packing and storage room over a quarter million dollars' worth of delicate silks or finest textiles, and so little do we fear the premature discharge that in the fire insurance we guarantee against this water damage with no additional charge.

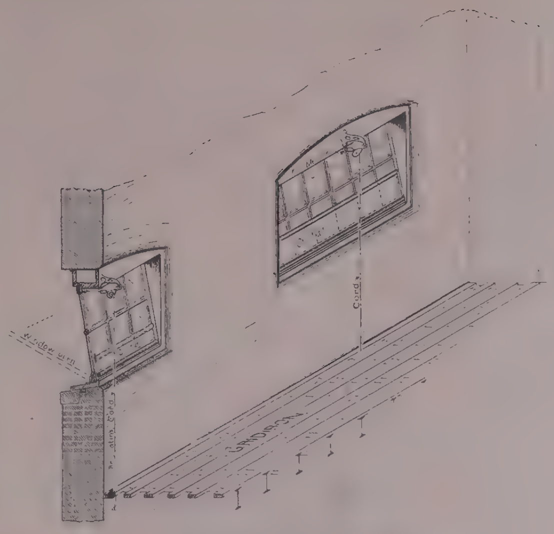
The idea that the fine spray or rain of water from a single opened sprinkler head falling vertically, and probably invisible to most of the audience, could produce a panic within the audience, however much it might disturb the chorus, is too absurd for serious argument. Sprinklers, although not so generally used over the stage as they ought to be, have been introduced here and there, and in some cities quite generally. I now have the record of about one hundred and fifty theaters that have been sprinkled. I have sent a circular letter to the managers of many of these theaters asking for their experience. In no case did I receive an adverse criticism and in the


Shutters of Wood Tin Clad Outside
Adjustable Weights
Window
Window
Operating Levers
Air Shaft
Shutter
Shutter
Area of Shaft 8'×12'-6"=100 Sq. Ft.
Area of Shutter Opening Same
Window
Window
Shutter

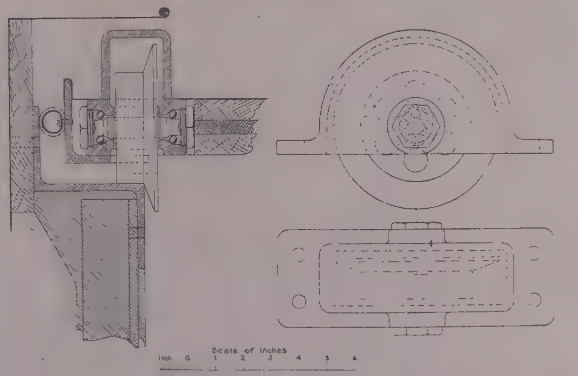
Smoke Vent Monitor Type
Horizontal Section



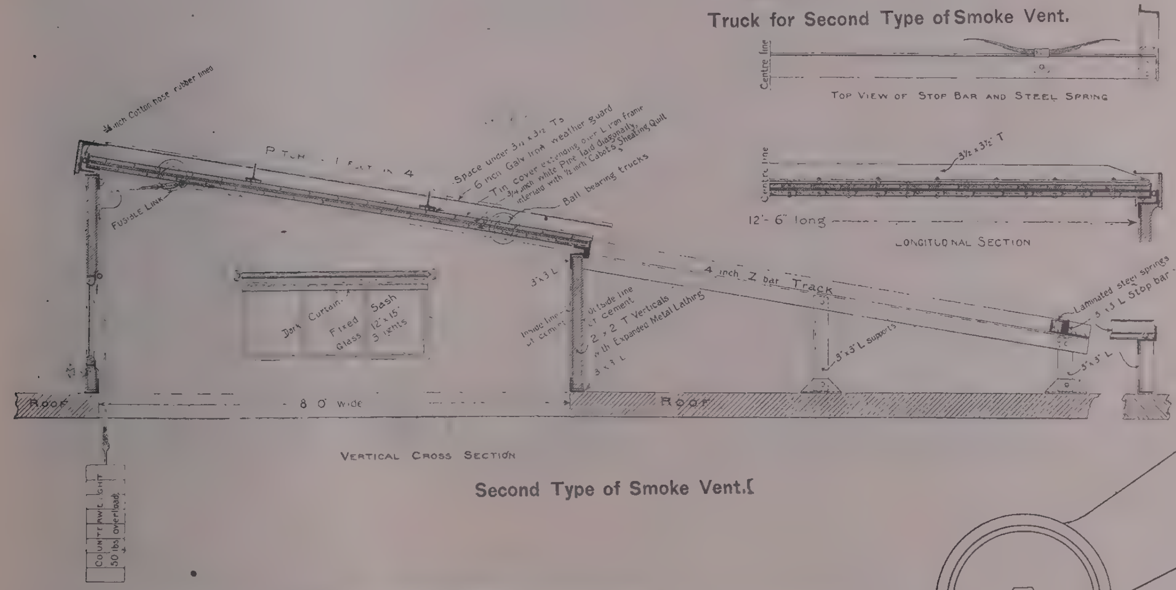
Smoke Vent Monitor Type
Side Elevation



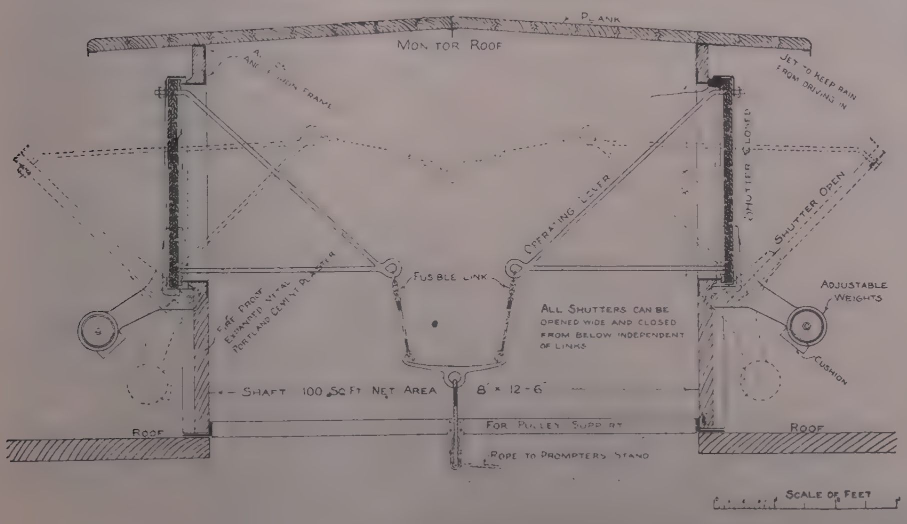
Third Type of Smoke Vent.



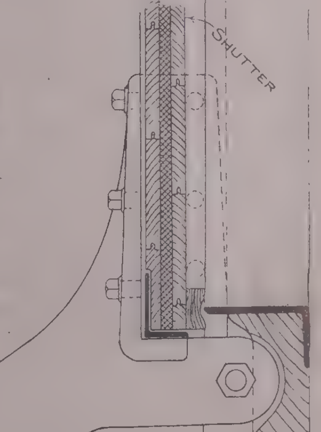
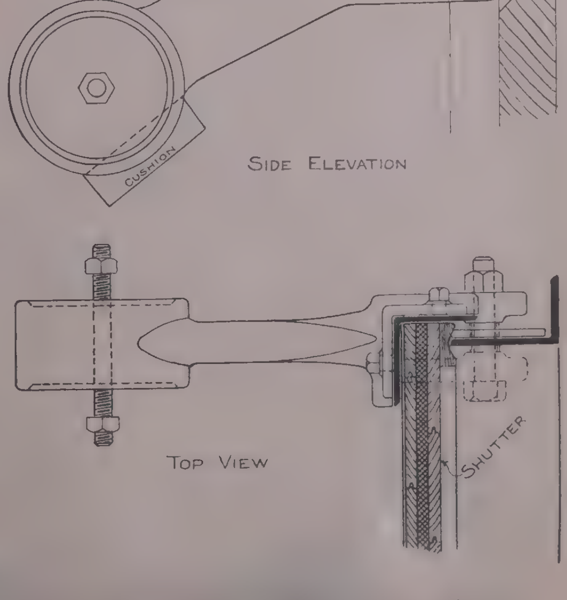
Truck for Second Type of Smoke Vent.



Second Type of Smoke Vent.


Plank
Monitor Roof
Angle Iron Frame
Jet to keep rain from driving in
Shutter Closed
Shutter Open
Operating Lever
Fire Proof Expanded Metal Portland Cement Plaster
Fusible Link
All Shutters can be opened wide and closed from below independent of links
Adjustable Weights
Cushion
Shaft 100 Sq Ft Net Area 8' × 12'-6"
Roof
For Pulley Support
Roof
Rope to Prompters Stand
Scale of Feet

First Type of Smoke Vent.

Weight for Shutter of First Type of Smoke Vent.

majority of cases they speak in most appreciative terms of the value of this safeguard.

(To be Continued.)

Book Notes.

Electrochemistry has now become so well-established as a science of great practical promise that a volume on "Experimental Electrochemistry," by Prof. N. Munroe Hopkins, of George Washington University, will doubtless find an appreciative audience, for it is both readable and accurate. The first 116 pages are devoted to fundamental principles and take up the theory of electrolytic dissociation, electrolytic induction and conduction, Faraday's law and energy requirements. A large number of experiments illustrating these principles are explained and illustrated. In the remaining 168 pages directions are given for making many compounds, both organic and inorganic, and for the isolation of sodium, potassium, aluminum and calcium, by electrolytic means. An interesting and valuable feature of the book is a short sketch of the history of some of the electrochemical advances along the lines covered by the contents. While the author has aimed mainly to prepare a textbook for school use, he has also produced a volume satisfactory for the general reader of technical books. (New York, D. Van Nostrand Co., $3.00.)

A handy little book of 59 pages, entitled "Mannheim and Multiplex Slide Rules," has been written by Mr. L. W. Rosenthal. The portion on the Mannheim rule is a complete discussion of the methods and limitations of that device, and the only criticism to be made of it is that the author does not explain the utility of gauge points in setting the slide for computations frequently needed. For example, it is often necessary in the editorial work of this journal to convert metric into American measures. In setting the rule for changing meters into feet it is much more convenient to set 82 to 25 than to set 3.28 on one scale to unity on the other. The use of gauge points is not so accurate as the setting of the conversion figure to unity, but it is accurate enough for a very large part of the computations made on the instrument. The second portion of the book describes the use of the multiplex rule, designed by the author. This is stated to have the following special advantages: Multiplication of three numbers in one setting, division of one number by two numbers in a single setting, more convenient solution of inverse proportions, direct solution in a single setting of a series of divisions with a constant dividend, direct reading of cubes and cube roots, direct reading of three-halves and two-thirds powers, direct solution in a single setting of many combined operations which require the slide to be shifted with the Mannheim rule. The rule resembles the Mannheim form save in two respects. One of these is the right-hand half of the upper scale on the slide, which is divided according to reciprocals, and the other is the use of a cube scale on the body of the rule, directly below the slide, occupying a place rarely used in such instruments. These innovations are decidedly interesting, as they enlarge the range of the Mannheim rule without in any way interfering with its usual manipulation. (New York and Chicago, Eugene Dietzgen Co., paper, 50 cts.).

The United States Department of Agriculture has recently issued a "farmers' bulletin" on "Cement Mortar and Concrete," written by Mr. Philip L. Wormeley, Jr., testing engineer of the Office of Public Roads, in which there is a large amount of useful information on the preparation and use of these materials for farm purposes. Now that cement is so cheap it is somewhat surprising its many advantages for certain purposes on farms are not better known. In Germany, concrete floors have long been used for stables, while concrete buildings are very common. A few American dairymen have recognized the advantages of concrete about stables, particularly in districts where the milk is inspected by public bacteriologists, and uncleanly surroundings are speedily made known to the public by the regular publication of the average number of bacteria in the milk furnished by each dealer. The use of concrete for silos, walks, fence posts and buildings is certainly deserving of more attention than it has received, and this pamphlet should be of value to those who have any such work in mind but are uncertain how to carry it out. There are two statements in it to which exception must be taken. One is that quick-setting Portland cement is usually inferior to that which sets slowly. Pure rotary-kiln cement is quick-setting, and it is made slow-setting by the addition of gypsum or plaster; excellent quick-setting cement can be furnished by any American mill on request. The second statement needing comment is that "concrete deposited in freezing weather will ultimately develop full strength, showing no injury due to low temperature." If concrete is placed in freezing weather and is not subject to numerous alternations of thawing and freezing it will prove satisfactory provided it is heavily loaded for a couple of weeks after it thaws out; if the fresh concrete is subject to repeated thawing and freezing it will probably go to pieces. Another point that might be dwelt on more at length in a pamphlet for general use is the distinction between the methods of working with dry and wet mixtures. Dry mixtures can be used to advantage in many places because they do not require tight forms, but such mixtures require far more tamping and more prolonged mixing of the dry materials before the water is added. On the other hand, wet mixtures require practically no tamping, but the forms must be tight. One feature of concrete work which was overlooked by the author is the necessity of keeping fresh concrete wet in case it is exposed to high winds or warm sunlight. Concrete becomes a stone by changes requiring plenty of water and a very common cause of failure to get satisfactory results is the drying out of the mass before the chemical changes of hardening are complete. Unless the weather is damp the fresh concrete should be covered in some way and kept wet by sprinkling for several days after it has been laid. An experienced concrete foreman may disregard this rule many times, but it is not safe for the farmer to do so.

Test of an Isolated Concrete Beam, Reinforced with Kahn Trussed Bars.

Notes on Heating and Ventilation. By John R. Allen. Chicago, Domestic Engineering; cloth, 16mo, 152 pp.

The author of this book is well fitted for writing it by his long familiarity with heating problems, gained as editor of "Domestic Engineering," and his duties as junior professor of mechanical engineering at the University of Michigan, where a large amount of experimental work in connection with heating and ventilating subjects has been carried on. The new material in the book is mainly in the data from these tests although some of the information concerning central heating systems is not readily accessible to most engineers. The book is essentially an explanation of the best practice in designing heating installations for houses, although there is considerable information concerning larger undertakings for office and manufacturing buildings.

In the introduction, the heat phenomena which must be considered in warming a building are explained, and in the first chapter the heat loss from buildings is discussed. The second chapter is an explanation of different methods of heating and their relative efficiencies. In three chapters Mr. Allen states concisely without needless technical verbiage the science of heating engineering, and his treatment of the subject is valuable because it shows why the German methods of arriving at the necessary radiating surface for a room are better than rules of thumb. Although both systems involve the use of coefficients which must be determined experimentally, the German methods call for coefficients of a logical nature instead of purely empirical factors.

In the portion of the book relating to practical design the author takes up in turn direct steam heating, indirect steam heating, steam boilers and steam piping. There is practically nothing in the book concerning hot water heating. Everywhere it is apparent that the installations which have proved successful are considered by Mr. Allen to be better guides to the designer than theory, and consequently there is practically nothing new in these chapters, only a straight-forward explanation of how to design such systems in accordance with current practice. The author then passes on to a consideration of ventilation. The reasons for providing for a change of air are stated in a short chapter, and then the hot air furnace and fan systems of warming and ventilation are taken up. The discussion is necessarily brief, but it covers the main features of the subject well enough to enable the reader to estimate the main elements of an equipment. The book is brought to a close with a good chapter on a central heating plant, containing illustrations of tunnels of novel cross-section used by Prof. Cooley, and a chapter on pipe covering and miscellaneous subjects. The book merits a wide circulation among steamfitters, for whom it was specially written, for it contains nothing about trade workmanship, which they already know, and explains the subjects taken up with unusual clearness and simplicity yet without sacrifice of accuracy in so doing.

A Screw Pump has been installed in an artesian well of the Fond du Lac Water Co. for use when the supply is low. The well has a 10-in. casing and is 756 ft. deep. Inside it is an 8-in. pipe containing the shaft, propellor and guides of the pump, which is the Wood type extensively used for irrigation purposes in Southern California. Originally the shaft was 95 ft. long but sand was discharged with the water under these conditions and the rod is now only 45 ft. long, at which depth, according to Supt. W. H. Masson, there is no trouble of this nature. The pump is driven by a 50-h.-p. Northern Electric, motor and delivers water at the rate of about 600 gal. a minute.

Letters to the Editor.

The Theory of Reinforced Concrete.

Sir: From a practical point of view, there are several marked discrepancies in the modern theory of reinforced concrete. The first to be noted is the impression that the ultimate strength of a beam is reached when it is so loaded that the steel is stressed to its elastic limit. In order to demonstrate this, experimenters have resorted to laboratory tests with concentrated loading on isolated beams. In practice, the writer has tested isolated beams until the ultimate strength of the steel in tension was reached. Therefore, the ability to do this, being possible, there is no reason why in calculation or theory that the ultimate strength should be assumed when the steel has reached its elastic limit. It would be just as reasonable to base the calculation of structural steel shapes upon a fibre stress of about 35,000 lb. ultimate, instead of 64,000 lb., as is commonly used. It has been said that a reinforced concrete beam, when the elastic limit of the steel is reached, is too much deflected to be desirable. However, the same may be said of the structural steel shapes when they are tested to that extent. If the elastic limit is used because it presents a more convenient basis upon which to determine the real strength of a reinforced concrete beam, then a factor of safety of about two in ordinary cases is sufficient.

Test Load on Floor in Warehouse for Farwell, Ozmun & Kirk, St. Paul.

As an illustration of the above remarks, kindly refer to the accompanying illustration of an isolated test beam. This was reinforced with two $1\frac{1}{4}$x$3\frac{3}{4}$-in. Kahn trussed bars, with a net area of steel of about 3 sq. in. The load of 91,500 lb. shown is practically uniform, and the resultant calculated stress in the steel due to this load, exceeds the elastic limit by about 5,000 per square inch. Surely no one could say that this beam, as illustrated, is completely destroyed, or even that it has reached its maximum efficiency. It would be extremely lavish to call this ultimate strength, and base practical application upon such a test, with a factor of safety of 4. All that would be required in this case is a factor of 2 on a load of 91,500 lb.

Another peculiarity determined from practical observation upon reinforced concrete construction is that the results obtained by testing isolated beams vary greatly from those results of tests on beam and slab floor construction, the latter being already in place in the structure. For instance, the writer has tested many floor slabs and beams in buildings and bridges, and placed over the entire bays a load which according to theory and calculation would bring the stress up to its ultimate strength in tension. Nevertheless, with this load, the floor showed only a very slight deflection. The reason for this remarkable result is probably the fact that good reinforced concrete construction when in a continuous floor slab forms the very best kind of a flat arch. Therefore, the arch action comes strongly into play when the floor is tested. If it is possible in testing a floor to get twice the calculated strength from same, then this should be taken into consideration in the design. The highest economy in reinforced concrete can only be obtained when one depends upon all the items of strength included in such construction. It is true, also, that the monolithic character of reinforced concrete construction adds greatly to the strength of its individual parts.

An illustration of a test such as outlined above is shown by the accompanying cut. This particular floor was designed for a safe load of 500 lb. per square foot, based upon the ultimate strength of the steel, with a factor of safety of 4. It was proportioned and designed according to the modern accepted theory. This floor is composed of girders 16 in. wide, and 24 in. deep, 16 ft. on centers, and beams supported by these girders are 14x16 in., 6 ft. on centers. On top of this is a slab $4\frac{1}{2}$ in. in thickness. All the above members are reinforced with Kahn trussed bars, containing diagonals in each case which reach to the top. This is an essential feature, because in order to get the best results from reinforced concrete, shear must be properly provided against. With a load of 1,500 lb. per square foot on this floor, the stress in the steel would be considerably in excess of the elastic limit. Nevertheless, with this load, there was no apparent effect upon the slab, the deflection being only 1/64 in. If this extra strength is adherent to reinforced concrete construction, then the same may be taken into consideration in the design.

The writer would be glad to supply information concerning at least thirty tests, in which the load was equivalent to stressing the steel to its ultimate strength in tension, yet at this loading each of these floors was in excellent condition, with slight, or no deflection.

Another point the writer wishes to bring out is the fact that laboratory tests, as are now being made, form an unfit basis for practical results. For instance, isolated beams are tested, and if these are reinforced properly against shear and tension, then the same will very likely fail by compression. However, in actual tests on complete structures, a failure by compression is almost unknown. If an isolated beam, however, is used in actual construction, then the same is reinforced for compression. Laboratory tests on isolated beams, should always be reinforced against compression in order to obtain results of practical value.

Very truly yours, M. Goldenberg.
Detroit, Dec. 7.

The Chittenden Reservoir.

Sir: We note in your issue for Dec. 9 an editorial article touching on the hydraulic works of the Chittenden Power Co., at Rutland, concerning which you published an account in the same issue. In your editorial you express some interest as to how far the estimated run-off will be realized in practice. The Chittenden Reservoir is located about at the center of a square with four U. S. Weather Bureau stations at the corners. In our report for 1901, using the Government data as a basis, we estimated a 36-in. mean rainfall and a 66 per cent. run-off. Very careful continuous weir measurements of the stream flow have been made since 1901 and careful rain gauge records have been kept at the dam. We have found a maximum precipitation of 53.3 in. and a minimum of 37.38 in., the latter covering what appears to be an extreme dry year for the surrounding stations. The run-off during this time has not varied one-quarter of one per cent. from 73 per cent. It is apparent, therefore, that so far as the water supply is concerned the results have been most satisfactory and our estimates have been more than sustained.

We were originally led to anticipate a high percentage of run-off by the character of the watershed and its altitude relative to the surrounding country. We did not, however, anticipate so large an increase in the rainfall over the neighboring districts.

The upper or regulating reservoir is, as you say, unusually large for the drainage area, but as the cost of obtaining this was not great, it was desirable to obtain a plant which would show absolutely a uniform flow except during the freshet season of a wet year. This result has been obtained and the plant is as flexible as a steam plant and entirely free from the low-water troubles of the average river powers.

Respectfully yours, Henry F. Bryant.
Brookline, Dec. 12.

Collapsible Steel Centers.

Sir: We note in your issue of Dec. 2nd a communication by Thos. C. Harris giving a drawing of a collapsible form for building concrete sewers and calling attention to the conveniences of such a form. Had Mr. Harris been a reader of your advertising columns he would have seen almost identically the same device illustrated on page 14 of the same issue. This device is patented and sewer centers are made by us in all sizes and shapes and are leased to contractors so that the cost is very much less than making and repairing wooden centers. These collapsible steel centers are made in short sections, interlocking together so that each section is very light and easily and quickly moved and set up by ordinary laborers, saving greatly in this respect over wooden centers, while at the same time a glassy smooth finish is given to the inside of the concrete sewer which can be obtained in no other way. These centers are in successful use on many large contracts. The enclosed cuts indicate clearly the operation of collapsing and the general features of the invention.

Yours truly,
Blaw's Collapsible Steel Centering Co.
Pittsburg, Dec. 5.

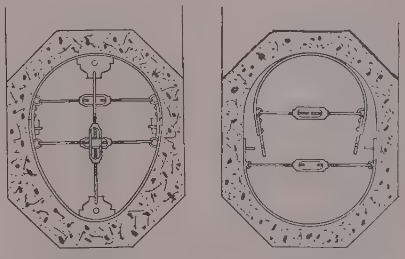
Tests of Reinforced Concrete Beams by the Chicago, Milwaukee & St. Paul Ry.

Sir: In your issue of Nov. 11 there was an abstract of a paper on tests of reinforced concrete beams, recently read by the writer before the Western Society of Engineers. The paper, which contained a number of typographical errors, was written with the intention of being supplemented when presented by oral explanations, and these typographical corrections and verbal explanations should have been incorporated in your abstract.

For instance, in conclusion 1, and again near the bottom of column 2, page 545, the statement "an amount of steel equal to 0.75 per cent.," etc., should have read, "an amount of high elastic limit steel equal to 0.75 per cent.," etc. Also, in a number of places, reference is made to "large size beams," which should have read, to bring out the meaning intended, "beams where the ratio of the depth to the length of span is large." A great part of the table given on page 545 is misleading owing to the omission of the explanatory notes and descriptive matter relative thereto. In the second paragraph, under the heading "Results," I was interested in learning that "the positions of the neutral axis were obtained by plotting the deformations of the neutral axis;" I had supposed that they were determined by plotting the deformations of the upper and lower fibres of the beams.

In the last paragraph, in column 2, page 545, the reference to the increased liability to diagonal failure when high elastic limit is used was not clearly stated in my paper. What it was intended to bring out was that the use of high elastic steel materially increasing the resisting moment of the beam, necessarily increased the shearing stress also, so that additional diagonal reinforcement would be required to develop the full elastic limit of the steel, over that required in a beam of equal dimensions reinforced with an equal amount of soft steel.

With reference to the beams 4 A-B-C, reinforced with Kahn bars, the writer, had he been given the opportunity, would have added something to the description in the way of an explanation, so that the patentee would not have considered that an injustice had been done to that bar. In order to obtain a proper comparison between beams reinforced with this bar, and those reinforced with the corrugated and twisted bars, the design of 4 A-B-C should be materially changed. In the first place, two bars, having a high elastic limit and longer prongs, should have been used. At the time the bars used in these test beams were purchased, the Trussed Concrete Steel Co. did not to the writer's knowledge manufacture a bar having a high elastic limit, or prongs longer than 18 in. The writer understands this is not true at the present time, and he regrets that the tests could not have been made with all of the reinforcing bars on a common basis. However, even as designed, the failure of beams 4 A-B-C was ideal in character, and from the table it will be seen that considerable more than the elastic limit of the steel was developed, which is all that could be desired, and all that can be said of any of the other bars, with the additional advantage that all of the failures were moment failures.



The Blaw Collapsible Center.

The writer does not wish to be understood as advocating the use of high elastic limit steel in all cases, or any certain percentage of any kind of steel for all classes of reinforced concrete work. The cost of the material and the character of loading must in each individual case determine whether a high or low elastic limit steel should be used, and whether the reinforcing metal shall amount to more or less than 0.75 per cent. of the area of the concrete. Where the steel reinforcement has an elastic limit as low as 35,000 pounds per square inch, the writer would, in work of the kind discussed in his paper, advocate the use of an amount equal to between 1 and 1¼ per cent. of the area of concrete above the steel. In other words, use an amount of low elastic limit steel that would give the same internal stresses in the beam as would be developed in a beam of equal dimension reinforced with 0.75 per cent. of high elastic limit steel.

The principal thing, therefore, that the writer desires to bring out, is the limitations that should be put upon these tests, and the conclusions that were drawn. It should be understood that these beams are designed for a specific purpose, namely, to bring out clearly the necessity of diagonal reinforcement in beams subject to excessive shearing stresses. It is not intended that the beams represent a design that could be used for all conditions of loading, but it is intended to bring out the advantage and necessity of placing shear bars in a beam to take up the tension due to shearing stresses and the disposition of these bars in the beams tested is correct, of course, only when the loading approximates that of a uniform load.

These explanations, I believe, cover all the points brought out in Mr. Ranson's letter, printed last week, except that part in which he appears to advocate the use of a certain patented bar. The writer has no desire to enter upon a discussion of this kind.

Yours truly, J. J. Harding.

The Constitution of Portland Cement.

The constitution of Portland cement may best be studied by determining the origin and nature of its two important mineral elements, alite and celite, which are distinguished by their optical properties. In a recent lecture before the Franklin Institute, Mr. Clifford Richardson pointed out that such an investigation cannot be made by purely analytical methods, but must be approached by the synthesis of materials which shall correspond in every way with the alite and celite of industrial clinker, whose constitution can be interpreted by the laws of physical chemistry, with the assistance of petrographic methods. By working in this way, Mr. Richardson has become convinced that alite is essentially a solution of tricalcic aluminate in tricalcic silicate, and celite is a solution of dicalcic aluminate in dicalcic silicate, the relative amounts of these constituents present in a clinker being regulated by the basicity of the material. If it is tribasic no celite is present, and if it is dibasic no alite is present. Unless alite predominates the material will not be a Portland cement, nor will it be unless there is at least three times as much silicate as aluminate, for the two classes of salt are not miscible with each other in every proportion. Other studies by Mr. Richardson indicate that on the addition of water to such an extremely basic solution of aluminates in silicates, free lime is liberated, which exists for a moment in the solution of water in a supersaturated state and from which solution it separates in a crystalline form, this going on continually. The crystals of lime evidently become fibrous eventually and bind together the collodial particles of the cement which are the result of the decomposition. This is the latest explanation of the setting of Portland cement.

A Forgotten Charge of Dynamite in a rock excavation was struck by a percussion drill in New York on Tuesday, producing an explosion injuring people a block away by the flying stones. Three workmen were killed.

CURRENT NEWS SUPPLEMENT

DECEMBER 23, 1905.

DIRECTORY OF NATIONAL TECHNICAL AND TRADE SOCIETIES.

American Society of Civil Engineers. Secretary, Charles Warren Hunt, 220 West 57th St., New York. Next meeting, Jan. 3. Paper on The Position of the Constructing Engineer; His Duties in Relation to Inspection and Enforcement of Contracts.

American Society of Mechanical Engineers. Secretary, F. R. Hutton, 12 West 31st St., New York.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York Next meeting, Jan. 26, 44 West 27th St., New York.

National Fire Protection Association. Secretary, W. H. Merrill, Jr., Chicago.

American Institute of Mining Engineers. Secretary, R. W. Raymond, 99 John St., New York.

American Institute of Architects. Secretary, Glenn Brown, Washington, D. C.

Association of Engineering Societies. Secretary, Frederick Brooks, 31 Milk Street, Boston, Mass.

American Society of Heating and Ventilating Engineers. Secretary, W. M. Mackay, 235 Water St., New York. Annual meeting, Jan. 16, 17 and 18, 12 West 31st St., New York.

Canadian Society of Civil Engineers. Secretary, Clement H. McLeod, 877 Dorchester St., Montreal.

American Public Health Association. Secretary, Dr. C. O. Probst, Columbus, O.

Society for the Promotion of Engineering Education. Secretary, Prof. M. S. Ketchum, University of Colorado, Boulder, Colo.

American Society for Testing Materials. Secretary Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Municipal Improvements. Secretary, George W. Tillson, Room 12, Municipal Building, Brooklyn, N. Y.

Association of Railway Superintendents of Bridges and Buildings. Secretary, S. F. Paterson, Concord, N. H.

American Railway Engineering and Maintenance of Way Association. Secretary, L. C. Fritch, 1562 Monadnock Block, Chicago.

American Water-Works Association. Secretary, J. M. Diven, Charleston, S. C.

American Foundrymen's Association. Secretary, Richard Moldenke, P. O. Box 432, New York.

Engine Builders' Association of the United States. Secretary, J. L. Lyle, 39 Cortlandt St., New York.

American Public Works Association. Secretary, W. H. Flint, Chattanooga.

Association of American Portland Cement Manufacturers. President, J. B. Lober, 1232 Land Title Building, Philadelphia.

American Society of Refrigerating Engineers. Secretary, H. W. Ross, Room 806, 258 Broadway, New York.

National Association of Manufacturers of Sand-Lime Products. Secretary, H. A. Duerr, Wilmington, Del.

National Association of Cement Users. President, Richard L. Humphrey, Harrison Building, Philadelphia, Pa. Annual meeting, Columbus, O., Jan. 10-13.

A NEW PIPE BENDING MACHINE.

The accompanying illustration shows a machine that has lately been perfected for bending cold steel, iron, brass, copper or other pipe up to and including 2 in. in diameter. The machine is also adaptable by means of special formers for bending light angles, flats or tee bars.

The gearing is compound with a ratio of 25 to 1, thus giving the machine a powerful leverage. A boy can bend 2-in. pipe with little effort. The machine is operated by a hand wheel with four handles, which, by means of the compound gearing, engages the face plate to which are attached the bending quadrants. The pipe is held in the quadrant at one end by a steel plate, while the resistance stud on the movable arm engages the other end. The various curvatures are obtained by adjusting the resistance studs movement in the T slot of the arm, which has a swing of three-quarters of a circle.

The machine is mounted on a telescopic stand, which can be raised or lowered to any height; when the base is fastened, the upper part swivels. A universal section or arm for the stand is furnished, so that, if so desired, the face plate may be placed in a horizontal position at any height from the floor.

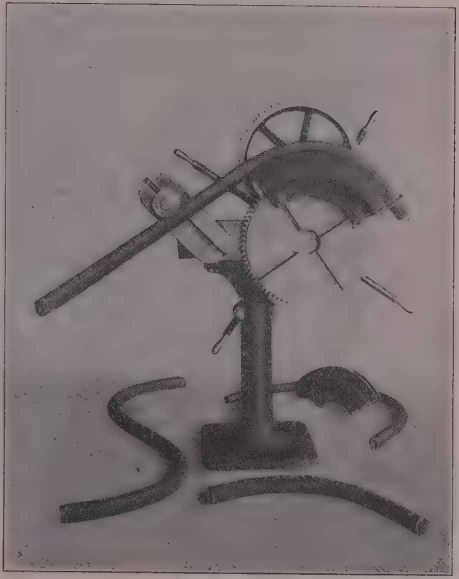
Quadrants are furnished for 1-in. pipe with a radius of 6 in., for 1¼-in. pipe with a radius of 9 in., for 1½ in. with a radius of 12 in. and for 2-in. pipe with a radius of 14 in. While these four quadrants are furnished with the machine, it is found that the smaller sizes of pipe can readily be bent in the larger-size quadrants very satisfactorily. In fact, workmen will not take the time to change the quadrants unless they desire a shorter radius than the larger quadrants will give them. The machine is manufactured by Pedrick & Smith, Germantown, Philadelphia.

THE IRON AND STEEL SITUATION.

The Lake Superior ore market has furnished in the week ending Wednesday noon, one of the most remarkable developments of this record-breaking year, according to the "Iron Age." At the end of the first week in December, with cargoes of 1905 ore still coming down the lakes, it was authoritatively estimated that nearly 90 per cent. of the merchant ores to be mined for 1906 had been sold. Careful computation also shows that counting in the ore of consumers having their own mines and of consumers receiving ore on long time contracts there has now been placed 96 per cent. of all the Lake ore available for next year. An output of 36,000,000 to 37,000,000 tons is now figured on for 1906, and of this only about 1,000,000 tons is still for sale.

Pig iron production is now on the basis of over 25,000,000 tons per annum. Our statistics for the month of November show that for that short month the production of anthracite and coke iron amounted to 2,014,021 gross tons, against 2,053,174 tons in October, a month of 31 days. Adding as a conservative estimate a monthly production of 30,000 tons of charcoal iron, the annual rate given above is reached. In November the steel companies contributed 1,334,644 tons to this total.

The event of the week is the announcement that the Cambria Steel Company has purchased 60,000 tons of Bessemer pig for forward delivery on the basis of monthly average prices. While the Steel Corporation has not yet bought its requirements for the first quarter it is understood that the metal will be available.



A NEW PIPE BENDING MACHINE.

The steel situation is growing serious with increasing scarcity. One large interest in Chicago estimates a shortage of 15,000 tons per month. The leading interest in the Central West is unable to operate as much finishing capacity as desired because the supply of sheet and tin plate bars is inadequate. In the East mills which until now were running on $23 and $24 steel must face the question of buying new supplies at close to $30.

The lake shipbuilders have received orders for six large carriers, two of them being 12,000-ton boats, for the Steel Corporation and two being for the Cambria Steel Co. and two for the Cleveland Cliffs Iron Co.

In the rail trade the only large transaction in the domestic market is a lot of 15,000 tons for Morgan's Louisiana & Texas Railroad. For the international markets and as possibly affecting our own mills there are two interesting orders at hand from Canada which aggregate about 85,000 tons. It is pretty certain that the Canadian mills will not be able to take any part of this business because they cannot meet the deliveries.

In the structural branch the leading contract of the week has been that for the Pennsylvania depot and power house, aggregating 25,000 tons. The principal sugar refining interest has purchased 15,000 tons for Southern delivery. All reports agree that the volume of business coming to the wire mills is exceptionally heavy. Instead of beginning to stock up for the spring trade, the mills are still forced to ship from stock. The tin plate and sheet mills, too, are very busy.

THE OPENING OF THE PHILADELPHIA SUBWAY.

On Dec. 18, the first section of the Philadelphia Subway was officially opened by the operation of surface cars on a five-minute schedule. These cars belong to one of the divisions of surface cars which run out Market St., and the section of subway now in use extends under that street from 15th St. to the Schuylkill River. After leaving the subway the cars cross the river on the new bridge connecting Philadelphia and West Philadelphia, erected by the Philadelphia Rapid Transit Co.

The subway is not entirely completed from 15th St. west, as there are to be four tracks, two for express trains and two outside for surface cars. For the express service the company will employ trains made up of all-steel cars which, after crossing the Schuylkill River will continue out Market St. on an elevated railway structure as far as 63rd St. The completion of the elevated structure, however, has been delayed by a strike, so that it will not be possible to put the elevated trains in service for some time. It was thought desirable, therefore, to utilize the subway for surface cars immediately and thus relieve a portion of Market St. of part of its traffic.

On Dec. 16, a number of prominent railway engineers and managers, city officials and others interested in city traffic made an informal inspection of the subway. They were the personal guests of John B. Parsons, president of the Philadelphia Rapid Transit Co., and about 500 were present. The subway was entered at the 15th St. and 19th St. stations. No attempt was made to run cars, as the guests preferred to walk through the underground passage, which was lighted by temporary fixtures as well as by the permanent lighting system. At one o'clock an elaborate lunch was served at the 19th St. station, which had been temporarily enlarged by extending the platform over the west-bound track. On Dec. 17, the Philadelphia Rapid Transit Co. expended a general invitation to the citizens of Philadelphia to visit and inspect the subway, and more than 50,000 people took advantage of this opportunity. Many of them walked the entire distance from 15th St. to the Schuylkill River.

An extended account of the subway was published in The Engineering Record of Feb. 25, 1905. The present completed subway section is a small portion only of the proposed rapid transit system. When completed there will be an elevated railway from 30th St. to 63rd St. The subway is to be extended east around the City Hall and thence under Market St. to Water St., where it will emerge through a portal on to an elevated structure which runs north on Water St., and east on Arch St. to the Delaware River and then south along the river front, a distance of a little over a half mile. This portion of the route will be double-tracked and is intended only for express trains. The two outer tracks in the present subway, which are to be used by the trolley cars, will branch off at the City Hall and will make a loop through the business district via Walnut St., Fifth St. and Arch St.

The subway section recently opened has a width of 48 ft. 6 in. in the clear between walls, and is 14 ft. high in the clear above the tops of the rails. The roof is formed of concrete arches, supported on steel I-beams, 5 ft. apart, placed across the subway and carried by three lines of columns. The side walls are of reinforced concrete, and the floor is of plain concrete. Terra-cotta ducts with manholes at frequent intervals are built in the south wall, forming the conduits for the electric feeders. The conditions as to underdrainage permitted the placing of subdrains below the floor of the subway, by which any appreciable head of water against the side walls is prevented. The underdrains include two lines of terra cotta pipe, one under each outside track, with laterals passing to the exterior of the side walls every 50 ft. The main drains lead to a pump well where the water is discharged into a sewer by electrically-driven centrifugal pumps regulated automatically by floats.

The lighting circuits in the subway are entirely separate from the power circuits. The subway is divided into sections about half a mile in length and the lamps at each station and for a distance half way to the next station on each side are supplied on a 110-volt circuit from a transformer located in the station. Each transformer substation is provided with a throw-over switch by which the lamps can be connected, if necessary, in groups of five, on to the railway circuit.

The track is quite novel as no ballast is used. The object is to keep everything in a perfectly sanitary condition, and the entire roadbed can be washed down with the hose and drained through sumps which are placed at frequent intervals.

As the local tracks are to be used by trolley cars they are equipped with an overhead wire which is supported in a special flexible suspension. This consists of two U-shaped brackets which are attached to brackets set in the concrete roof of the tunnel while the latter was being built. The express tracks and elevated structure will be equipped with a third-rail system. At present the express tracks will be equipped with the trolley system and will be used by the trolley cars until the elevated structure is completed.

An interesting feature of the subway construction is the arrangements for ventilation which have been provided at different points. In addition to the openings into the street at the different passenger stations there are special chambers which are connnected to stacks outside. Arrangements have been made at the base of these stacks for the installation of fans if necessary, but in most cases it is thought that the natural draft will be sufficient. There are three of these stacks on the section now completed, and others will be constructed on private property on the section of the subway which will next be opened.

TESTING HIGH POWER MODERN GAS ENGINES.

In a paper read before the Technological Society of Kansas City, last month, Mr. Wm. H. Spiller stated that a great many readers of even the technical papers do not know that the modern gas engine has to undergo prolonged and severe test in the factory, far more critical than the majority of steam engines ever pass through. The duration of these tests vary from one week to fifteen days, according to the size of the engine, the work it has to perform and the distance it will require to be shipped.

It can readily be seen that in a piece of mechanism weighing from 25 to 50 tons, some of the parts will weigh from one to five tons, and that these various parts must represent a great deal of money expended for making and the high-class labor of finishing, to say nothing of the cost of the splendid grade of material required for this type of power machinery. As these engines are sold under a positive guarantee covering consumption of fuel per horse-power per hour, workmanship, material and general efficiency under actual operative conditions, the reason for the excellent exhaustive testing is at once apparent. The manufacturer cannot afford to run any risk of a shut down of a plant from any cause after installation on the customer's foundations. The expense of shipping, the services of the erecting engineer and his expenses from the factory are considerable, therefore, the manufacturer takes the trouble and expense of assuring himself, as well as protecting his customer, that there will be no flaws, no trouble of vexatious delays; but a perfect working, economical and absolutely reliable, up-to-date power, placing the gas engine in a field distinctively its own, acknowledging no competition, bowing to no other power.

The first tests, Mr. Spiller said, are made by the chemist when he analyzes the pig iron or steel as received from the mill, and this analysis must tally with the specifications calling for the particular grade required for certain parts of the machine. Then when a heat is run, a test piece is made and put under test until it is fractured and the ultimate or breaking strength known and then the unit stress per square inch with a proper factor of safety for the material is determined.

The factors of safety in gas engines are very high for the strains are exceedingly complex, there sometimes being not only compression and tension strains, but also cross or transverse strains in the various parts. When a casting has been made in the foundry it is gone all over with powerful blows delivered with a heavy hammer to ascertain if the casting is perfect, and if any chambers have been cored, this will show if there are any thin or weak spots in the walls. If any defects develop the piece is immediately rejected. After the cylinders have been finished, and before assembling the engine, they are tested under a high water pressure with a special device, and the pressure, number of the cylinder and engine recorded.

The various materials and parts of the engine having passed these preliminary but very systematic tests and then being assembled, forming the completed engine, the cams and gears set correctly for the proper timing and igniting of the gases in the cylinders, the valves in proper position for admitting and exhausting of the gas, the engine is then ready for its initial run.

The indicator, so familiar to steam engineers, is used and a card is taken from each cylinder on the engine. These large engines are started by means of compressed air, admitted through an automatic starting valve to one cylinder, and the engine operates by this means until gas has been drawn into the other cylinders upon the descent of the pistons, compressed and ignited, and then upon shutting off the compressed air and admitting gas to the first cylinder it immediately assumes its cycle of operations upon gas, giving its power also. The compressed air is supplied by means of a small two or three horse-power gas engine, air compressor and air receiving tank, furnished with every plant.

The indicator cards taken from the engine show the exact amount of compression in pounds per square inch of the mixture of gas and air, the pressure of the burning gases after ignition, the pressure of the exhaust, also whether the intake and exhaust valves are set properly for the highest economy and whether the ignitors are timed accurately for igniting the gas at the proper point of the stroke to gain greatest power.

The valves on these large engines being operated positively by mechanical means and as they are provided with a device for adjusting to 0.001 inch, it can be understood what an excellent opportunity is presented to the engineer for securing an efficiency and economy absolutely unapproachable in Mr. Spiller's opinion, by a steam engine or any other type of power.

Some manufacturers have been in the habit of cataloguing their engines under the indicated horse-power, and there are records of test runs made of gas engines showing the fuel economy per horse-power a great deal higher than that of other engines. Had these same engines been tested under a brake load and that test been published, Mr. Spiller said, it would have been the correct way to list and sell an engine, as the purchaser would know how much power he is going to have actually delivered to the belt after consuming a certain amount of fuel.

In making the test of the brake horse-power, a Prony brake is used, consisting of a large cast-iron ring, having both inwardly and outwardly projecting flanges. The inner flanges serving as a trough to hold the water necessary to keep down and absorb the excessive heat developed when the engine is delivering a great amount of power. A small pipe standing at the proper height allows the water to flow into the ring, maintaining a constant amount of water necessary to supply the loss from rapid evaporation and the heat is partially dissipated in the form of steam, and the excess of water carried away by means of an overflow pipe.

TESTING A WEBER PRODUCER GAS ENGINE.

The accompanying illustration shows a test being made of a 300-h.p. producer gas engine operating upon pea coal and consuming less than one pound per brake horse-power per hour, in the manufacturing establishment of the Weber Gas & Gasoline Engine Co., Kansas City, Mo. At the time the picture was taken the engine was delivering about 350-h.p. and the clouds of steam from the brake obscured part of the view.

The outer flange on the ring serves to hold in position the brake strap to which shoes of wood are riveted. This strap is provided with two powerful hand wheels at the back for tightening and increasing the friction on the ring or drum. Lubrication is supplied from pieces of tallow placed between the blocks of wood. The band or strap has a lever rigidly attached and firmly braced to it at different points.

The drum is bolted to the fly-wheel and revolves with it; the brake arm resting upon a knife edge on top of the wooden stand on the platform scales prevents the brake from revolving when the strap is tightened, and allowing the downward push to be weighed in pounds and fractions on the scale.

The engine is run at normal speed and the strap is tightened until the speed of engine remains constant and carries the proper load in horse-power, as indicated by the weight necessary to balance the scale.

The brake horse-power is computed by multiplying the pressure upon the scale in pounds by the length of the brake arm in feet, times the revolutions of the drum per minute, by the decimal 0.0001904. The length of the arm is taken as the distance from the center of the engine shaft to the knife edge on top of wooden stand on the scale. The weight of brake arm and wooden stand is deducted from the total weight as registered by the scale.

Other tests of these engines Mr. Spiller proposed to take up in a future paper.

LITIGATION OVER THE BOSTON DRY DOCK

The taking of testimony has now begun in the claim presented to the Court of Claims by the Receiver of the City Trust Safe Deposit and Surety Company, of Philadelphia, based upon the construction of the dry dock in the Boston Navy Yard. This claim amounts to $411,406.48. It is by no means singular that a legal dispute should have arisen in regard to this dry dock, for hardly a single dry dock has been constructed in recent years by the Navy Department without a legal controversy, either by way of a suit on behalf of the contractors against the United States, or a suit by the United States against the contractors or their bondsmen.

The claim presented by the contractor in this case consists of fifteen different items. The principal items rise out of the question of the coffer dam construction; the substitution of plans by the department, and the delays in stone inspection. It will be remembered that the construction of the coffer dam at this dock and the break in it was the subject of an article in this paper in August, 1900, by Civil Engineer Maxson. The contractor, in his petition in the Court of Claims, alleges that the coffer dam as built complied strictly with plans imposed upon the contractor by the Navy Department, and that the plans which the contractors themselves offered and favored were not allowed to be used. There were three breaks in the coffer dam and these were repaired at very great expense to the contractor; the total items of the claim arising out of the coffer dam matter alone amounting to over $75,000.

The claim is also made that after the proposal of the original contractors was accepted, based upon alternative plans, they were required to build the dock according to a third plan upon which they had not bid at all, at an expense of over $50,000.

The original contractors, O'Brien & Sheehan, the City Trust Company having taken up the contract as surety, very promptly made an extremely advantageous contract for cutting and delivering stone, and the petition states that they were ready to ship stone promptly. During the whole of this time the Government failed to inspect the stone, or even to furnish storage room in the Navy Yard where it could be piled to await inspection. During this time the market price of stone was continually rising, and the result of the delays, the claimant says, was an increased cost of nearly $250,000.

The taking of testimony began at Waterbury, Conn., and will be continued in Boston, New York and elsewhere. Not less than a month's time will be consumed on this alone. The claimant is represented by Mr. George A. King, of Washington, as attorney, and with him is associated at the taking of testimony, and with engineering expert, Mr. J. J. de Kinder, of Philadelphia. The interests of the United States will be looked after by Assistant Attorney Philip M. Ashford, of the Attorney General's department.

An intervening petition has been filed in the case of O'Brien & Sheehan, the original contractors, in which they ask that judgment be rendered in favor of their sureties.

AN ENGINEER'S UNIQUE ENTERTAINMENT.

"The resident engineer of the Sixth Street Viaduct requests the honor of your presence at an informal compressed air smoker in the Kaw River, forty feet below the surface, air chamber of Caisson Pier 2, Kaw River bridge, Sixth Street Viaduct, 8 P. M., Saturday, Dec. 9, 1905, Kansas City, Mo. Wear your sweater and cap, and your boots."

The above invitation was recently received by a number of engineers and others of Kansas City interested in details of construction, and the very general acceptance and attendance made this unusual smoker a most interesting social diversion. The caisson which they were invited to visit and inspect is one now being sunk for the channel pier of the Kaw River bridge of the Sixth Street viaduct. It proved to be a very convenient "banquet room," being 22 ft. x 56 ft. outside dimensions, and 16 x 50 ft. inside, with an 8-ft. ceiling; and was at the time in coarse clean sand and carrying a pressure of about 20 lb.

The guests gathered about sixty strong and were conducted over a tramway to the pier, where they were taken down into the caisson in squads of six. The "ushers," who were the assistant engineers and inspectors on the work, divided the task of going through the lock with the novices and instructing them in the tricks of the trade. After reaching the air chamber cigars and cigarettes were passed around to the professional and amateur "sand hogs" and the visitors, after recovering their confidence, proceeded to examine the interior of the caisson and to observe the method of doing the "sand hog" work. About forty were inside at once, some being taken out as the others were brought in. Nearly all the guests were "green," and while some were somewhat scared they all went through safely. After coming out they were taken to the office, given an electric shock, and served with club sandwiches and liquid refreshments. This latter courtesy was extended by Kahmann & McMurray, the contractors doing the pneumatic work, by whose permission the smoker was held. Notwithstanding the fact that some of the visitors acknowledged that while in the lock they frankly wished they had not come, still all, on returning to the surface, expressed their high approval of the whole unique occasion; and while it may be said the guests were "under pressure," and did not largely express a wish for a repetition, still this smoker will be remembered by all present.

The host of this occasion was Mr. Ernest E. Howard, resident engineer for Waddell & Hedrick, who are the consulting engineers of the viaduct. This Sixth Street viaduct now being built is to connect by means of an elevated roadway and car track the cities of Kansas City, Mo., and Kansas City, Kan., across the valley of the Kaw River. The main viaduct without approaches is over 8,000 ft. long, and the whole is to cost about $2,500,000.

THE MECHANICAL FILTERS AT HAVRE DE GRACE, MD.

Some time ago the Havre de Grace Water Co., of Havre de Grace, Md., made extensive improvements in its plant, including the addition of mechanical filters, built by the Roberts Mfg. Co., Philadelphia. There has been some controversy concerning the efficiency of the means of purifying the water and the company accordingly engaged Mr. Alfred M. Quick, engineer of the Water Department of Baltimore, to make an examination of the equipment. In his report he states that the criticisms of the plant's efficiency seem to have been based on the results of four analyses of the raw river water, which were considered to show its unsuitability as a source of water supply, and a few analyses showing that the filtration process did not reduce the bacteria. Mr. Quick gives figures to show that the bacteria indicated by these analyses were fewer in numbers than those in other river waters used as sources of supply, while six analyses of the effluent of the filters made under his direction indicate only three to five bacteria per cubic centimeter. Consequently, he believes that there is no reason why the river should not be used as proposed, but suggests that two sewer outlets should be closed so that no sewage from them will reach the intake of the water-works. This change has lately been made by the city.

When the plant was first installed there was no apparatus at hand for adding the coagulant and as a temporary expedient a bag was filled with the coagulant every two hours and kept hanging in the sedimentation tank. This naturally caused a variation in the amount of coagulant in the raw water, but as an automatic apparatus has since been installed the condition is one that need no longer cause adverse criticism. It was also asserted against the plant that the sedimentation tank was of inadequate capacity, but Mr. Quick does not hold this view. Its capacity relative to the rate of filtration is much greater than that of many recently installed mechanical filters, being over twice as large proportionately as that of the Brooklyn plants.

It was also asserted that the plant was improperly operated. On this point the consulting engineer states that both the superintendent of the company and the engineer of the plant have offered to make sworn statements that the filters have always been properly washed, that the coagulant has been applied continuously and regularly, and that no raw water or wash water has been pumped into the mains. In Mr. Quick's opinion the filters are operated as efficiently as necessary and the plant is "well-designed and constructed, with all the parts of sufficient size for the work to be done."

SMELTING MAGNETIC IRON ORE BY ELECTRICITY.

As the result of experiments in the concentration of black sands, which he conducted at the Lewis and Clark Centennial Exposition in Portland, Ore., during the past summer, Dr. David T. Day, of the United States Geological Survey, makes the noteworthy statement that conditions for the production of steel by electricity are fully as good in Oregon as they are in Germany, where pig iron has been obtained in similar electric furnaces at slightly lower cost than in ordinary blast-furnace practice.

A preliminary report on the subject of smelting by electricity the magnetic iron ores obtained from various points on the Pacific beach has been submitted by Dr. Day to the Director of the Geological Survey.

After considerable correspondence with the patentees of various forms of electric furnaces, arrangements were made with the Wilson Aluminum Co., of New York, for the services of Mr. C. E. Wilson, their expert in electrical smelting. Mr. Wilson arrived in Portland on Oct. 11, and at the end of one week had erected a small but efficient electric furnace, and was making steel. He had procured in the East 25 carbon electrodes—each 48 in. long and 4 in. square—such as are ordinarily used in electric furnaces. The rest of his equipment was obtained in Portland from materials kept in stock or easily made at a foundry.

In building the furnace a course of ordinary Carnegie fire bricks was laid upon the ground. Upon this single course was laid a cast-iron plate, ⅝ in. thick, 3 ft. long, and 3 ft. wide. On this was placed an oval sheet-iron drum of No. 16 iron 3 ft. long by 3 ft. high. The sides of this drum were lined with fire bricks to form a crucible 18 x 18 in. and 24 in. high. The bottom of the crucible was covered, from the cast-iron plate up to the tapping hole, with broken carbon electrode. The carbon electrode to carry the current was suspended by a pulley above this furnace and connected with a balanced axle and wheel by which it could be readily raised or lowered. The top of the furnace was covered with two double plates of riveted wrought iron, between which cold water was run. In the center of this water-jacketed cover an opening was left sufficient to allow the free play up and down of the carbon electrode. This furnace is referred to as "Small Furnace," or "Furnace A."

Through the co-operation of the Portland General Electric Co., a special wire, bearing a 2,300-volt alternating current, was run from the city supply to the smelter. This was carried into a series of six transformers and yielded a current varying from 50 to 20 volts by 1,000 to 2,000 amperes.

On the afternoon of Oct. 17 a current of 57 volts and 1,000 amperes was passed through the furnace and the arc established. The furnace was then fed with a mixture of magnetite, coke and lime. This consisted of 200 lb. of magnetite, obtained from the sand at Hammond Station, near Astoria, Ore., at the mouth of Columbia River; 44 lb. of "Fairfax" coke, which contained about 25 per cent. of ash; and 24 lb. of lime. About 150 lb. of this charge was slowly introduced into the furnace, and within an hour there was tapped from the furnace 70 lb. of steel and slag, which contained 8 per cent. of iron and 53 per cent. of titanic acid.

On the following day the furnace was again heated and filled with a mixture similar to that used on the first run, except that it contained less lime. Steel was successfully cast twice, making, for that day's run of two hours, a product of 90 lb. of steel from 300 lb. of iron ore. This gives the furnace a capacity, on a continuous run, of 1,440 lb. in 24 hours.

The iron ore fed to the furnace showed the following percentages of magnetic oxide, of titanic acid, manganese, and undetermined matter: Fe_3O_4, 79.06; TiO_2, 16.00; MnO_2, 2.45; silica, moisture and undetermined matter, 2.49. It will be noted that the heat was sufficient to keep the entire slag in a fluid state whether much or little titanic acid was present. It is evident also that no titanium went into the iron. Instead of the steel usually obtained, the charge of Oct. 20, as shown by the analysis of that day, gave what was practically pig iron.

The slags first obtained consisted of fused iron silicates, fused oxide of iron, and silicate of titanium. Later in the experiments these slags grew lighter in color and in specific gravity. It became possible also to lessen the quantity of slag produced, which was unduly large owing to the great quantity of ash in the coal. The coke used showed on analysis 41 per cent. of ash. It is difficult to procure in this locality coke that is well adapted to metallurgical needs.

Experiments with the small furnace having been successful, it was thought desirable to build a larger furnace, with thicker walls, in which higher temperatures might be obtained and maintained. An iron plate 2 in. thick, 5 ft. wide, and 6 ft. long was therefore procured and laid upon two courses of fire brick, to form the base of a furnace, on which was set a wrought-iron cylindrical shell ¼ in. thick, 5 ft. in diameter, and 4 ft. high. This was lined with fire brick, the bottom having the usual lining of one course of carbon electrode bricks 4 in. in diameter. Two carbons clamped together with a water-jacketed head or clamp formed the electrode for introducing the current. The voltage was run up as high as possible—that is from 75 to 90 volts, the limit of the current obtainable over the wires. In all respects except these mentioned, this second furnace is identical with the first.

Iron ore from Aptos, Bay of Monterey, California, was smelted in this furnace on Nov. 10. This iron ore is very fine grained and contains a notable percentage of manganese, much of which goes into the steel. It is not so rich in titanium as the other sands that had been used. From the start this furnace made a satisfactory run, maintaining easily a high temperature and turning out a very smooth product. After a few trials the slag became as light in color as that from any well regulated blast furnace. The later products of steel were much denser than those first made, which would seem to indicate that, at the higher temperature, the process of reduction is complete, even in the short time that elapses between the beginning of reduction and the tapping. In every case, however, small blow holes were observable in the steel. These were due to gases which formed wherever grains of magnetite were still entangled in the steel in process of reduction. The capacity of this furnace with a current of 125 volts, 1,200 amperes, would be 2,000 lb. in 24 hours.

BUSINESS NOTES.

The business of the T. L. Smith Co., of Milwaukee, has increased to such an extent that the company has been forced to give up its old offices for much larger quarters in the Merrill Building.

The David Bell Engineering Works, steam hammer specialists, of Buffalo, have incorporated with H. T. Dunbar as president, David Bell vice-president and general manager, F. C. Slee secretary, and George B. Bell treasurer. The company is now making single frame hammers with fall weights of 250 to 2,500 lb., double-frame hammers with weights up to 5,000 lb., and steam drop hammers of 400 to 2,000 lb.

The Chicago Pneumatic Tool Co. has been awarded a gold medal at the Liege Exposition, covering pneumatic tools and appliances, and a silver medal for Franklin air compressors. The gold medal was the highest award for pneumatic tools and appliances and its receipt maintains the company's record of always receiving the highest honors since its first exhibit made at the Cotton States Exposition at Atlanta, Ga., 1895.

The name of the Selvey-Wyckoff Co., of Springfield, Mass., has been changed to the Wyckoff & Lloyd Co., with Mr. R. T. Wyckoff president, and Mr. Henry W. Lloyd treasurer. Mr. Wyckoff was treasurer of the Selvey-Wyckoff Co. from its formation in 1898, and Mr. Lloyd has been secretary for more than three years. Its specialties are heating and ventilating, plumbing and mill supplies, including heavy engine and boiler connections.

The Westinghouse Electric & Manufacturing Co. is now furnishing equipments for an unusually large number of industrial power plants of a diversified character. Among recent shipments are included one to the Lehigh-Northampton Gas & Electric Co., Catasauqua, Pa., of a 150-kw., 350-volt, three-wire, engine-type generator and two auto transformers; to the Keystone Coal & Coke Co., Keystone, W. Va., one 250-kw., 550-volt, engine-type generator and a 60-kw., two-phase, 1,100-volt alternator; to the Granite City Hospital, Granite City, Ill., a 35-kw., 250-volt, type S engine-type generator, and many others could be mentioned. Owing to the magnitude of the works of the Westinghouse Electric & Manufacturing Co., many people have received an erroneous impression that the product of this company consists principally of the larger types of electrical apparatus. The aggregate business of this company, on the contrary, in the smaller units far exceeds that of the larger and special types.

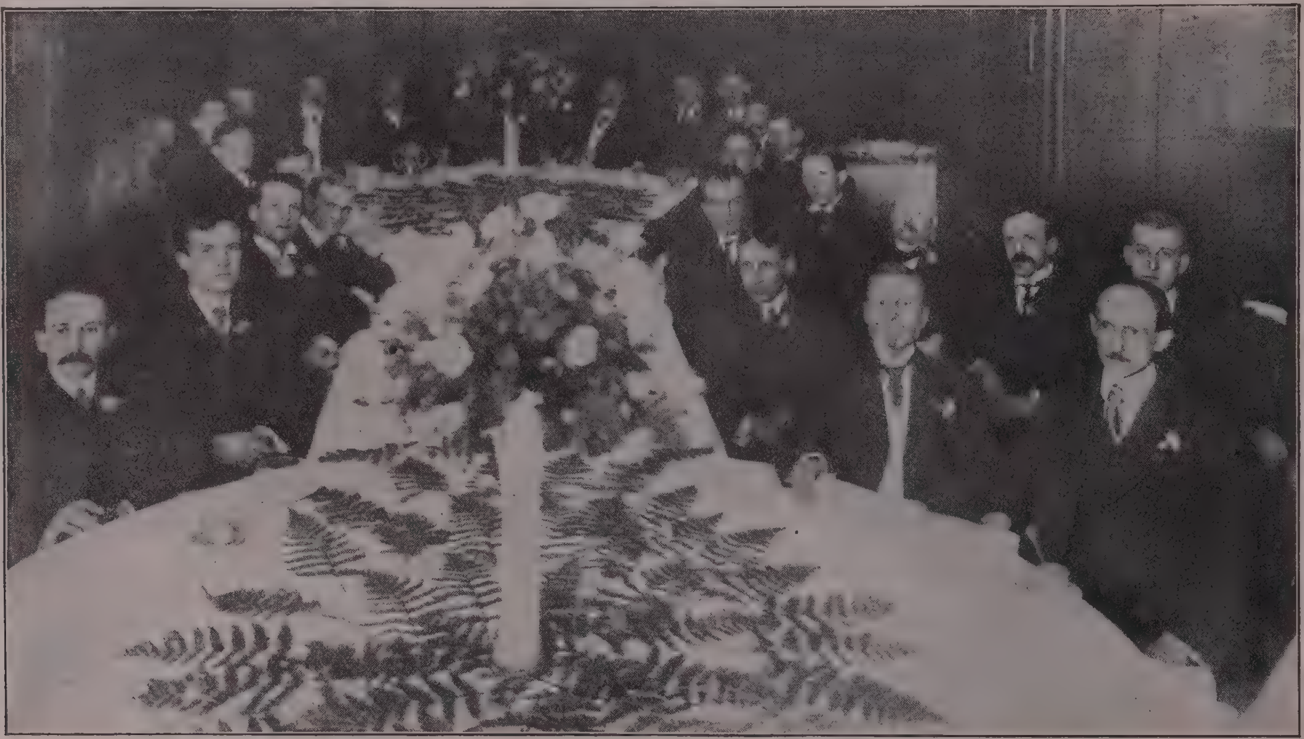
The Miller-Collins Co., contracting engineers, 1133 Broadway, New York City, have been awarded the contract, on their guaranteed cost plus lump sum profit contract, for the designing and erection of the new foundry building at Long Island City, for the Union Ballast Co., of New York. The building will be on pile foundations, with concrete block walls, structural steel frame, plank and composition roof. Work to be started at once. The Miller-Collins Co. are in the market for prices on cement, sand, piles, lumber, sash, doors, window frames, roofing and structural steel, etc., etc.

Messrs. Watson & Szlapka, 54-55 Baxter Bldg., Philadelphia, have been awarded the eastern agency of the Dayton Hydraulic Machinery Co., of Dayton, Ohio, the manufacturers of the Brooks Centrifugal Pump.

The work of grading and excavating at the new open hearth steel plant and rolling mill of Milliken Bros., at Staten Island, has already progressed to a considerable extent and some of the material for the new steel plant has already begun to arrive. The contract for the rails for the tracks, amounting to 800 tons, has been placed with the Pennsylvania Steel Co. The ties for the tracks have already been delivered. The order for switches has been placed with the Pennsylvania Steel Co.; the order for the yard locomotives, of which there are five, has been placed with the H. K. Porter Co.; the contracts for the 40-in. blooming mill, the 32-in. roughing mill, and the 28-in. finishing mill, have been placed with McIntosh, Hemphill & Co., of Pittsburg.

The Engineering Agency, of Chicago, is undergoing a thorough reorganization and expansion. Mr. A. G. Frost, who has been at the head of the organization for four years as secretary and manager, has been elected vice-president and treasurer. Mr. R. D. Smith, who has been with the company for a number of years, was elected second vice-president and general manager, and Mr. Paul W. Herring was elected secretary. It is the plan of the Agency to start offices immediately in Pittsburg, New York and Denver, besides the present offices in Chicago. In the last week of November the Agency filled 90 positions ranging from $20 to $75 per week, including managers, superintendents, engineers, draftsmen, etc. In the month of November it filled 283 positions; in the last thirteen years over 10,000 technical positions.

Mr. F. M. Farmer, of the Electrical Testing Laboratories, New York, is now in the Westinghouse Works at East Pittsburg, Pa., conducting acceptance tests on a large order of electrical apparatus, including two 1,500-kw. generators, nine 1,000-kw. transformers, rotary converters, smaller transformers, etc., for the Grand Rapids-Muskegon Water Power Electric Co., of Grand Rapids, Mich.



THE GATHERING OF OFFICERS, REPRESENTATIVES AND BUSINESS ASSOCIATES OF THE CONTRACTORS' SUPPLY AND EQUIPMENT COMPANY.

The Robins Conveying Belt Co., New York, has recently secured a large order for a series of conveyors for ore bedding purposes for the Garfield plant of the American Smelting & Refining Co. Among other orders now on hand is one from the Western Engineering & Construction Co., of San Francisco, for a 34-in. conveyor to be installed on a gold dredge in the Oroville District. This conveyor will be equipped with the Robins new style five-pulley troughing idlers. The Robins Co. has also received an order from the Pittsburg Reduction Co., for a belt conveyor intended for their East St. Louis Works.

Among the contracts for heating and ventilating equipment for industrial plants recently taken by the B. F. Sturtevant Co., Boston, may be mentioned the following: Ventilation equipment for the bleaching room of the Arnold Print Works, North Adams; heating system for the heater room and store houses of the Eastern Mfg. Co., South Brewer, Me.; heating and ventilating system for a 30-stall roundhouse of the Intercolonial Ry. at Truro, N. S.; a heating and ventilating system for the wet machine room, grinding room and tempering building of the Spanish River Pulp & Paper Co., Espanola, Ont.; heating and ventilating equipments for the rolling mills and machine shop of the National Tube Co.: for the machine shops, blacksmith shop and foundry of the Fairbanks Morse-Canadian Mfg. Co., Toronto, Ont.; for two paint shops of the Pressed Steel Car Co., at McKees Rocks and Allegheny, Pa.; for a building of the Brown & Sharpe Mfg. Co., at Providence for an office building of the Studebaker Bros. Mfg. Co., at South Bend; for the new machine and smith shops of the Pennsylvania R. R., at Hollidaysburg; for the machine room of the Piermont Paper Co., Piermont, N. Y.; for the Lockhart Mills, at Lockhart, S. C.; for the new weave shop, dye building and finishing building of the Arlington Mills at Lawrence, and for the Saxon Mills at Spartanburg, S. C. These installations call for a great variety of apparatus, some of it electrically operated.

The Santa Cruz Portland Cement Co., San Francisco, Cal., has recently ordered one 800-h.-p., ten 250-h.-p., fifteen 150-h-p., one 75-h.-p. and one 30-h.-p. motors. These are all alternating current motors of the induction type and aggregate a total of 5,655 h.-p. The order was taken by the Westinghouse Electric & Mfg. Co

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A NOTEWORTHY GATHERING OF CONTRACTORS' MACHINERY MEN.

On the night of Dec. 4th, the Contractors' Supply & Equipment Co., Chicago, held a banquet at the Chicago Athletic Club in which about twenty-five of their representatives participated. This banquet was planned about thirty days before this time, in celebration of the sale of the 500th Smith mixer sold in 1905, but when the celebration finally came off, they had passed the 500th mark and had sold 563 up to Dec. 8th.

Mr. T. L. Smith, president of the Contractors' Supply & Equipment Co., also president of the T. L. Smith Co., manufacturer and inventor of the Smith mixer, gave a very interesting history of the development and progress of the mixer and its sale. The first Smith mixer was made in the summer of 1900 and sold to the Northwestern Tile Co., of Milwaukee. It was an eminent success from the start and is in constant use to-day, after five years of continual service. This machine demonstrating the success of the type, Mr. Smith began the regular manufacture in 1901, during which season 47 mixers were built and sold. At this time, the Contractors' Supply & Equipment Co. of Chicago, which had been organized by Mr. G. C. Marsh and had been local agent for the Smith mixer during the previous year, took the exclusive sale of this machine. In 1902, 155 machines were sold. In 1903, 285 mixers; in 1904, 375, and in 1905, up to the present time, 589. These figures do not include about 75 which were sold in foreign markets. During the present year, the demand has been so great that, had the factory had the capacity, at least 300 more machines could have been sold.

The management of the Contractors' Supply & Equipment Co. are free to give great credit for their rapid success in putting the Smith mixer on the market to their liberal use of the advertising columns of the technical and trade papers.

After Mr. Smith had finished his talk, a beautiful solid silver loving cup was set before him, a gift from his associates, and he indicated his appreciation of this unexpected demonstration of the feelings of his friends in a very neat speech.

Among those who attended the banquet were the following: Mr. T. L. Smith; Mesrs. W. H. C. Mussen and Chadwick, the Canadian representatives, who have sold something over 100 mixers in their territory; Mr. John L. Kirk, the Pittsburg representative and director of the Contractors' Supply & Equipment Co., who has sold 100 Smith mixers in the territory adjacent to Pittsburg; Mr. G. E. Ingersoll, representative in St. Paul; Mr. J. Power Hely, of St. Louis; Mr. W. E. Austin, of Atlanta, Ga. In addition to these selling agents there were present: Mr. G. C. Marsh, treasurer and general manager of the Contractors' Supply & Equipment Co.; Mr. E. B. Kelley, vice-president and New York manager of the company; Mr George D. Smith, secretary; Mr. John Smith, superintendent of the T. L. Smith Co.; Mr. W. J. Buckley, secretary of the T. L. Smith Co.; Mr. Sharp, of Sharp Bros. Co., manufacturers of the boilers used on the Smith mixers; Mr. Irving Smith, son of Mr. T. L. Smith; Mr. C. A. Baker, of the Sterling Wheelbarrow Co., Milwaukee, whose product is handled by the Contractors' Supply & Equipment Co.; Messrs. F. B. Wright, John M. Trevor and A. M. Boughton, salesmen for the Contractors' Supply & Equipment, and the balance of the office force.

THE CONVENTION OF THE NATIONAL ASSOCIATION OF CEMENT USERS.

The National Association of Cement Users' Convention will be transferred from Milwaukee, Wis., to Columbus, Ohio, owing to the burning of the Exposition Building at Milwaukee. As 10,000 sq. ft. are required for the exhibits of the association, this fact made it difficult to secure adequate quarters. Columbus, Ohio, was finally selected. As the Governor's Inaugural Ball will be held on Jan. 8, the dates of the convention have been advanced one day, thus making the convention cover Jan. 10 to 13 inclusive. It was not an easy proposition to secure adequate quarters, as the exhibits of machinery, cements, etc., at the convention will be unusually large. The association is to be congratulated in having secured such quarters in the limited time in which it was compelled to make the change.

The Department of Publicity of the Allis-Chalmers Co., Milwaukee, Wis., has issued an elaborate catalogue of its line of crushing rolls, which includes three styles, the first the Gates high-grade roll, the second the Fraser & Chalmers standard roll, and the third the Fraser & Chalmers old-style belt roll. The catalogue not only describes the sizes which the company aims to carry in stock, with a full line of repair parts, but also gives tables of special sizes made to order, and of apparatus for somewhat similar purposes.

Compressed air displacement pumps are described in a booklet issued by the Ingersoll-Rand Co., New York. Two types are explained, differing mainly in the fact that one of them uses the same air volume over and over again, while the other does not. These pumps have marked advantages for raising small or large quantities of water under certain conditions, and the managers of industrial works and contractors who use much compressed air machinery will be repaid for reading this pamphlet.

PERSONAL NOTES.

Maj. A. C. Negley has been appointed city engineer of Florence, Ala.

Mr. George P. Zwerner has been elected superintendent of the Marysville, O., Light & Water Co.

Mr. E. D. Fletcher has been appointed chief engineer of the Tacoma Eastern R. R., succeeding Mr. Henry Shaw, resigned owing to ill health.

Dr. Edward B. Ellicott has been reappointed electrical engineer of the Chicago Drainage Trustees, in charge of water power development.

Mrs. William E. Mott, wife of Prof. Mott, of the Massachusetts Institute of Technology, formerly of Ithaca, died in Brookline, Mass., on Dec. 11.

Mr. Wm. G. Snow has resigned from Francis Bros. & Jellett, Inc., to become manager of the New England office of Warren Webster & Co., at Boston, Mass.

Mr. J. E. Chisholm has been appointed general master mechanic of the Chicago Great Western Ry., with headquarters at Oelwein, Ia.

The Municipal Civil Service Commission of New York City will hold an examination on Jan. 24, of candidates for the position of inspector of cement tests.

Messrs. L. B. Stillwell and John Van Vleck announce the removal of their electrical and general engineering offices to 100 Broadway, New York.

Mr. W. H. Nicholay, of Newark, N. Y., has been appointed superintendent of the western division of the New York State Canals.

Mr. Fred. Maltby, division engineer, and Mr. L. E. Dubois, superintendent of construction, of the Isthmian Canal Commission's staff, returned North last week on leave of absence.

Mr. Allen Hazen, of New York, has been awarded a gold medal by the commission of awards of the Louisiana Purchase Exposition for designs for water and sewage filters.

Asst. Civil Engineer J. S. Schultz, U. S. N., has been transferred from the Brooklyn Navy Yard to Schenectady, as inspector of electric work at the shops of the General Electric Co.

Mr. T. Chalkley Hatton, of Wilmington, Del., has been appointed consulting engineer of Pensacola, Fla., and Mr. J. N. Hazlehurst, of Mobile, has been appointed city engineer.

Mr. D. B. Merry, of Tulsa, Ind. Ter., has been appointed chief engineer of the Tulsa, Texas & Gulf Ry., which is projected from Tulsa through San Antonio to Matagorda Bay, on the Gulf of Mexico.

At the annual meeting of the Rochester, N. Y., Engineering Society last week, Mr. George T. Otis was elected president, Mr. Jacob M. Floesch first vice-president, Mr. Allen S. Crocker second vice-president, Mr. John F. Skinner secretary, and Mr. Wm. J. Stewart treasurer.

The Brooklyn Engineers' Club held its annual meeting on Dec. 14, when Mr. Willard S. Tuttle was elected president, Mr. Joseph Strachan secretary, Mr. John Middleton treasurer, and Messrs. Laurence J. Carmalt and Kingsley L. Martin directors.

At the recent annual meeting of the Engineers' Society of Western New York, Mr. Louis H. Knapp was elected president, Mr. Soren M. Kielland vice-president, Mr. George A. Ricker director, Mr. Thomas J. Rogers secretary, Mr. Dennison Fairchild treasurer, and Mr. William A. Haven librarian.

Mr. N. Neff, engineer of maintenance of way of the Chicago terminal division of the Pennsylvania lines, has been appointed superintendent of the Richmond division of the Panhandle road. Mr. R. C. Barnard, formerly a civil engineer, has been appointed superintendent of the Cincinnati division.

Mr. Wm. T. Blunt, who has been connected with government engineering works for the greater part of the time since 1879, and for the last twenty years as U. S. assistant engineer on harbor works in the Cleveland district on Lake Erie, has been given an indefinite furlough and will enter contract work at Boston, with Messrs. Geo. H. Breymann & Bros., on Jan. 1.

About forty alumni of Purdue University, living in the vicinity of New York, organized on Dec. 18 the Purdue University Alumni Association of the City of New York. Mr. P. E. Fansler, of J. G. White & Co., was elected president, and Mr. L. M. Grant, of the C. W. Hunt Co., secretary and treasurer. The association starts off with about 100 members.

Mr. Arthur N. Johnson, recently appointed state highway engineer of Illinois, is particularly well qualified by education and experience to inaugurate the road improvements of that state. He was graduated from the Lawrence Scientific School of Harvard University and served as an instructor there for two years. He then became an assistant engineer on the staff of the Massachusetts Highway Commission and later highway engineer of the Maryland Geological Survey. In the latter office he had to spread the glad tidings of good roads before a decidedly stiff-necked generation, but while progress was slow it was also steady, and his missionary work is now showing good results. For a year or so he has been connected with the Office of Public Roads at Washington, and has been engaged to a considerable extent in field demonstrations of good road building in various parts of the country.

Mr. Edmund M. Blake will open an office on Jan. 1 at 8 Beacon St., Boston, for general engineering practice in sanitary, hydraulic and municipal work. He is a graduate of the Lawrence Scientific School, with experience in structural steelwork in the offices of the Eastern Bridge & Structural Co., of Worcester, and the Brown Hoisting Machinery Co., of Cleveland. For about two years he was an assistant engineer under Mr. Alfred Craven on the second division of the New York subway, and for the last four years he has been engaged with Mr. Percy M. Blake, of Hyde Park.

William H. Shock, engineer-in-chief, U. S. N., retired, although considerably younger than his former superior, Mr. Charles H. Haswell, the nestor of American engineering, was 84 years of age at the time of his death, which occurred on Monday. He entered the navy as a third assistant engineer in January, 1845, and served during the Mexican war. After its close he was engaged for a time on the construction of the machinery of the Merrimac. During the civil war he was fleet engineer of the west gulf squadron for some time. In 1877 he was appointed chief of the Bureau of Steam Engineering, a position he retained until 1883, when he was retired for age, with the rank of commodore.

The merger of various traction companies in Indiana and Ohio has progressed far enough for the officers to be elected. Mr. Hugh J. McGowan, president of the Indianapolis Traction & Terminal Co., will be president of the company in charge of the Indiana lines, and Mr. W. Kelsey Schoepf, president of the similar Ohio company; these gentlemen will also hold positions as vice-presidents of the Ohio and Indiana companies respectively. Mr. McGowan will turn over the duties of general manager of the Indianapolis Traction & Terminal Co. to Mr. Robert I. Todd, at present general manager of the Rhode Island Co. Mr. Elbert D. Peck has been elected first vice-president of the Indianapolis Traction & Terminal Co. Mr. Charles Murdock, vice-president of the Ft. Wayne & Wabash Valley Traction Co., has been elected first vice-president of the new Indiana company and Mr. C. C. Reynolds general manager. It is interesting to observe that several of these officers are well known in engineering circles. Mr. McGowan was long engaged in the asphalt pavement industry, in which Mr. Peck was also interested at one time. Mr. Todd is a graduate of Johns Hopkins University and an engineer as well as an executive officer.

Gen. Herman Haupt, who died suddenly on a train near Jersey City, on Dec. 14, was graduated from the United States Military Academy seventy years ago, but resigned from active service soon after receiving his commission, to take up railway engineering in Pennsylvania, in which he achieved high distinction, both as chief engineer of the Pennsylvania R. R., general manager of the Northern Pacific R. R. and head of the military transportation bureau during the Civil War. In a very interesting autobiography written several years ago he described in a vivid manner some of the perplexities which arose to cause trouble in his long and varied career. For many years he was engaged in a struggle with the authorities of Massachusetts concerning the Hoosac tunnel, the story of which was recently told in the "Springfield Republican" substantially as follows: It was back in 1856 that Herman Haupt & Co. entered into their first agreement with the Troy & Greenfield R. R. They were to build the railroad and to tunnel the mountain for $3,880,000, to be divided as follows: $2,000,000 from the state, $900,000 in mortgage bonds of the company, $598,000 in capital stock, and $382,000 in cash. But the weak and struggling railroad company failed to meet the cash payment, and that contract failed. The Legislature was appealed to, and the terms of the state's loan act was modified and passed. But the know-nothing executive, Gov. Gardner, vetoed it. He showed that he knew much, however, in declaring that the provision for building the tunnel was inadequate, and that it could not be finished before 1874. Whereby he came close to the historic fact. Subsequently the Berkshire people were able to obtain the desired modifications of the loan act, and work was kept up by Herman Haupt & Co. until 1860. Then the Legislature, through a special committee, inquired into the progress of things upon the Hoosac mountain, and decided that too much had been claimed by the contractors as accomplished, in order that the money on the contract might be drawn from the state treasury. During 1860 and a part of 1861, the work was continued, until the total advance of money made up to July, 1861, was some $778,675. At this point a new state engineer, Mr. Whitewell, took hold, who became convinced that his predecessors had been dealing too generously with the contractors, and hence he cut down the amount claimed by them by $100,000. The work was then suspended, and the Haupt contract closed. Just here a violent controversy broke out, of the kind that was frequent during the entire progress of the work upon the Hoosac mountain. The contractors were savagely assailed as having purposely failed in the details of the work, while they claimed to have followed the plans of a previous state engineer, and that the work condemned by Mr. Whitewell was strictly in accordance with the limits laid down by his predecessor. An appeal was taken to Gov. John A. Andrew, who sustained the new policy of the engineer, though his council and legislative committees sided with the contractors. The matter was warmly debated in the session of 1862, where, after a long and bitter contest, the state became fully committed to the completion of the tunnel by the appointment of a board of commissioners to assume direction and possession of the road, under the several mortgages given by the Troy and Greenfield railroad company. Massachusetts then began to build the tunnel, and pushed it through, Haupt & Co. assenting to the possession of the state Dec. 23, 1862.

TRADE PUBLICATIONS.

Frahm's speed indicator, frequency teller and revolution counter, is described in a pamphlet issued in several languages by Friedrich Lux, Ludwigshafen am Rhein, Germany. This remarkable instrument was devised by Mr. Hermann Frahm as a result of important investigations of the torsional vibrations in propellor shafts, and depends upon the property that elastic bodies possess of being set in vibration if subjected to rhythmic impulses of a frequency corresponding with the natural period of vibration of the bodies themselves. The instrument can be attached directly to the steam turbine, fan, milk separator or other apparatus to be indicated, or it can be connected with it electrically, so that the indications may be read at a considerable distance.

Bulletin 359 of the National Electric Co., Milwaukee, Wis., describes at much length the details of the polyphase induction motors made by the company. These are regularly made for 25 and 60 cycle circuits and from 1 to 75 h.-p. in capacity. Bulletin 363 from the same company is an interesting explanation of stationary and portable electrically driven air compressors for continuous and intermittent service. These machines are coming into marked favor for the operation of pneumatic tools.

The Pressed Steel Pole Co., of Pittsburg, Pa., has issued a well-illustrated pamphlet describing poles made of sheets of structural steel pressed and bound together with clips so as to have a square cross-section. They are used for telephone, telegraph and trolley wires, railway signals and similar purposes.

The American Steam Gauge & Valve Mfg. Co., of Boston, has issued a folder describing the American-Thompson indicator and explaining the new detent motion to assist in changing cards. The mechanism for the purpose is all inside the drum so that nothing has to be attached to the indicator when using it.

The B. F. Sturtevant Co., Hyde Park, Mass., has issued a bulletin describing its Class VS5 vertical engines. These are high-speed automatic engines with forced lubrication and have been designed particularly for driving direct-connected generators. They are made with cylinders from 5 x 5 to 12 x 10 in. and the bulletin describes their more important details and lists their leading dimensions.

Henry Pels & Co., 68 Broad St., New York, have published a little booklet based on the assumption that their machinery is best advertised by its users. They acordingly give letters from seventeen important companies concerning their experience with the Johns patent beams shears. The writers cover the country from Portland, Me., to San Francisco, and their letters are particularly interesting as being all new, although the machines referred to were bought several years ago.

In the December number of "Cementology," published by the Whitehall Portland Cement Co., Philadelphia, there is an interesting discussion of standard requirements for Portland cement, in the light of the methods of testing outlined by the American Society of Civil Engineers and the specifications adopted by the American Society for Testing Materials.

The new bulletins of the General Electric Co., Schenectady, N. Y., are as follows: No. 4,423, 1,150 and 2,300-volt alternating-current switchboard panels, designed for central stations of medium and small capacity; No. 4,424, Edison incandescent lamps for stereopticons, magic lanterns, projectors, headlights, etc., which are made in ratings of 20 to 100 cp. at a normal power consumption of about 4 watts per candle; No. 4,425, 4,500-volt oil-break switches, type F, form K3; No. 4,426, CL-B slow and modeate speed belt-driven generators; No. 4,427 type MC governor for electrically driven air compressors, its purpose being to stop the motor driving the compressor when the maximum air pressure has been reached and to start it whenever the pressure falls below a predetermined minimum.

CONTRACTING NEWS
OF SPECIAL INTEREST TO CONTRACTORS, BUILDERS, ENGINEERS AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES.

WATER.

Notes Arranged Alphabetically by States.

Argenta, Ark.—See "Power Plants, Gas and Electricity."

Santa Monica, Cal.—The Bd. of City Trus. is reported to have accepted the City Engineer's estimates and plans for the municipal water works. An election will soon be held to vote on issuing $250,000 bonds for same.

La Junta, Colo.—S. W. Brown, City Clk., writes that surveys and plans are now being prepared for the construction of a pumping station for the water works. Engineers, Burns & McDonnell, Dwight Bldg., Kansas City, Mo.

Berthoud, Colo.—Engr. Anderson is reported to have recommended to the Town Council the construction of a sand filter at the town lake at a cost of $6,000 also that the surface of the lake be raised 2 ft. for a greater pressure.

Ft. Morgan, Colo.—Bids will be received until Jan. 2 by the Bd. Dirs. (Galwey Layton, Secy.), Bijou Irrigation Dist., for $750,000 bonds.

Palatka, Fla.—Bids will probably be called for in 30 days for the construction of water works. Wm. W. Lyon, of Palatka, is consulting engr.

Key West Barracks, Fla.—Bids will be received until Jan. 15 by Lieut. Col. Sam. R. Jones, Ch. Q. M., U. S. A., Atlanta, Ga., for furnishing material and constructing a 104,000-gal. concrete cistern, 2 concrete cisterns, 14,000 gals. each, and enlarging a cistern now in use.

Nampa, Idaho.—Claude Duval, City Clk., writes that bids for bonds to be used in the construction of water works and sewerage system were opened on Dec. 11. It has not yet been decided when bids will be received for construction; cost reported to be $27,000.

Joliet, Ill.—John Beckwith, Supt. Water Wks., is reported to have recommended a new 6,000,000-gal. pumping engine for the water works.

Chicago, Ill.—Bids will be received by the Dept. of Pub. Wks. (Jos. M. Patterson, Comr.) until Dec. 30, for furnishing material and constructing a Portland cement concrete lined water tunnel, about 22,700 ft. long, including certain shafts, said tunnel being Section No. 1, Southwest Land Tunnel, as advertised in The Engineering Record.

St. Charles, Ill.—F. E. Glenn, Mayor, writes that the proposed water works will cost about $50,000. No bids called for construction as yet.

Brockton, Mass.—Chas. R. Felton, City Engr., has rendered a report on increasing the water pressure 30 lbs. for fire purposes. If adopted it would entail the construction of new stand pipe, about 6,000 ft. of 30-in. main, and changes in the pumps.

Pittsfield, Mass.—The city has ben making investigations of its water system to find leakages in the works. Pitometer work is to be done under John A. and Edward S. Cole, consulting engineers. Some surveys have been made to determine possible sources of additional supply.

**St. Paul, Minn.*—The County Comrs. are reported to have awarded to the St. Paul Artesian Well Co. the contract for putting in a 12-in. well at Silver Lake, for about $2,000.

St. Cloud, Minn.—The City Council is reported to have requested A. P. Starkey, Asst. City Engr., of St. Paul, to visit St. Cloud, to advise the city with regard to improving the water supply.

Clinton, Minn.—Bids will be received until Jan. 8 by the Village Council (J. L. Erickson, Pres.) for $6,000 bonds, proceeds to be used to build and complete the water works system.

Hattiesburg, Miss.—The City Council has passed an ordinance authorizing the issue of $200,000 bonds for public improvements, including $150,000 for street paving, $35,000 for the improving and extending of the water works and $15,000 for the improving of the sewerage and extensions of mains. The material to be used in paving is to be vitrified brick and the streets include all the business portion of the city and a good part of the residential districts. It is stated that the paving work is to be commenced at once.

Wood River, Neb.—See "Power Plants, Gas and Electricity."

Montclair, N. J.—A committee of ten has been appointed to inquire into the advisability of purchasing the present plant or constructing municipal water works. D. D. Duncan, Mayor.

Rahway, N. J.—The proposed filtration plant for Rahway, if constructed, will cost from $40,000 to $50,000. J. B. Furber, Mayor.

Orange, N. J.—Rudolph Hering, of New York, N. Y., is reported to have completed plans for a new reservoir; the plans include a filtration plant and storage reservoir, with a capacity of 3,000,000 gals., near South Orange Ave., and the cost will be about $250,000. Fred. T. Crane, City Engr.

Malone, N. Y.—The Village Clerk writes that the citizens voted Dec. 12 to issue $200,000 bonds, to purchase present water works or install a municipal system.

New Brighton (S. I.), N. Y.—Bids will be received until Dec. 28 by John T. Oakley, Comr. Water Supply, Gas and Electricity, New York City, for furnishing, delivering and laying water mains in numerous streets, Boro. Richmond.

Watervliet, N. Y.—The army ordnance officers at Watervliet arsenal have sent plans and specifications to Washington, D. C., which have been approved by Gen. Crozier, Ch. of Ordnance, contemplating improvements at the arsenal to the extent of $24,000, including the construction of new coal sheds, an increase in the water supply, a feed water purifier for the boiler shop, repairs to the steam heating system, rebuilding of the railway trestle and an oil house.

Albany, N. Y.—Bids will be received by the Bd. of Contract and Supply until Jan. 15 for Contract No. 2, improvement of the water supply, for pumping engines, at the Quackenbush St. Station, as advertised in The Engineering Record.

New York, N. Y.—Bids were opened on Dec. 13 by John T. Oakley, Comr. Water Supply, Gas and Electricity, for furnishing, delivering and laying water mains in Columbus and 9th Aves., 62d St., Central Park West and in Central Park. The following are the totals of bids received including valves and boxes, hydrants, etc., also unit prices on some of the items required: (*a*) Continental Asphalt Pavt. Co., 42 Bway., $520,282, (*b*) E. Schroeder, 215 W. 125th St., $519,745:

	a	*b*
7,800 tons straight pipe	$29.30	$32.80
500 tons special castings	65.00	62.50
5,500 cu. yds. rock excav., without blasting	5.00	4.00
2,500 cu. yds. rock excavation	3.50	4.00
1,000 cu. yds. masry. excav., without blast.	3.50	4.00
64,000 cu. yds. earth excav	.80	.75
54,000 cu. yds. fill. and embkt	.10	.20
1,100 lin. ft. 60-in. pipe	4.00	2.20
14,500 lin. ft. 48-in. pipe	2.50	1.75
5,300 lin. ft. 36-in. pipe	2.00	1.20
250 lin. ft. 30-in. pipe	1.75	1.10
100 lin. ft. 24-in. pipe	1.25	1.00
700 lin. ft. 20-in. pipe	1.00	.80
23,000 lin. ft. 12-in. pipe	.50	.50
6,500 lin. ft. 6-in. pipe	.20	.25
2 20-in. x 20-in. connections without shutting off water	360.00	300.00
2 20-in x 12-in. connections, without shutting off water	150.00	150.00
3 20-in. x 6-in. connections, without shutting off water	125.00	100.00
7 blow-offs to set	60.00	10.00
100 lin. ft. of 24-in. vitr. drain pipe	2.25	2.00
3,000 lin. ft. 6-in. vitr. drain pipe	.30	.50
750 cu. yds. brick masry	15.00	15.00
750 cu. yds. concrete masry	8.50	7.00
300 cu. yds. rubble masry	4.00	4.00
300 cu. yds. dry stone masry. and riprap	2.50	1.50
6,200 sq. yds. asphalt pavt. and asphalt or artificial stone sidewalk	2.80	3.25
250 sq. yds. granite block pavt. on concrete tar and gravel or cement joints	2.00	1.50
1,500 sq. yds. telford macadam pavt., driveway, bridle and foot paths	1.00	2.00
19,000 sq. yds. pavt. and flagg	.60	.20
2,500 lin. ft. curb and gutter	.20	.10
10 M. ft. sheet piling and timber	40.00	40.00
6,000 lbs. wrought iron or steel installed complete	.05	.04

College Point, L. I., N. Y.—Bids were opened on Dec. 13 by John T. Oakley, Comr. Water Supply, Gas and Electricity, N. Y. City, for furnishing, delivering and laying water mains in Van Alst, Harris, Woolsey and other streets in College Point, Queens Boro.; the following are the totals of bids received including valves, hydrants, etc.; also unit prices on some of the items required: (*a*) D'Ambra & Trucillio, 205th St. and Villa Ave., N. Y. City, $93,174; (*b*) L. D. Gregory, 125th St. and 1st Ave., N. Y. City, $102,795; (*c*) Pease Bros., Flushing, L. I., $106,239; (*d*) Norton & Dalton Contr. Co., 27 W. 140th St., N. Y. City, $104,845; (*e*) Clinton Beckwith, 49 W. 27th St., N. Y. City, $97,907, and (*f*) P. T. Brennan, 759 E. 173rd St., N. Y. City, $97,417.

	a	*b*	*c*	*d*	*e*	*f*
1,465 tons straight pipe	$33.00	$34.00	$29.50	$31.00	$33.00	$31.00
150 tons branches, spec. castings and gate valve boxes and covers	65.00	65.00	60.00	65.00	65.00	59.00
950 cu. yds. rock excavation	2.00	3.00	5.00	4.00	3.50	....
1,000 cu. yds. extra excavation	2.00	.75	.50	1.00	.47	....
29,064 lin. ft. 12-in. pipe, inc. excav. and fill	.35	.55	.46	.60	.40	.50
120 lin. ft. 8-in. pipe, inc. excav. and fill	.25	.55	1.00	.60	.36	.38
11,400 lin. ft. 6-in. pipe, inc. excav. and fill	.25	.36	.38	.60	.27½	.34
1-6-in. wet connection to 12-in. pipe	20.00	100.00	95.00	40.00	75.00	85.00
1-6-in. wet connection to 8-in. pipe	20.00	80.00	75.00	40.00	50.00	80.00
19 16-in. wet connection to 6-in. pipe	20.00	65.00	75.00	40.00	40.00	75.00
250 sq. yds. sheet or block asphalt pavt. and artificial stone sidewalk, including foundation	2.00	4.00	5.00	4.00	4.00	3.00
1,200 sq. yds. pavt. and flagging	.10	.50	.60	.50	.30	.50
150 lin. ft. boxing for 12-in. pipe	2.00	10.00	8.00	5.00	5.00	2.50

Granville, N. D.—It is reported that estimates are being prepared for water works.

Hobart, Okla.—Bids will be received by the Mayor and Council until Jan. 9 for drawing plans and specifications for the extension of about 4 miles of 6-in. mains and a water tower, as advertised in The Engineering Record.

Sharon, Pa.—The Sharon Water Co. is reported to have decided to expend about $12,000 in improvements.

Mill Hall, Pa.—A charter is reported to have been granted to the Crystal Pure Water Co., of Mill Hall. This company is an auxiliary of the West End Co., of Lock Haven, and will receive its water from this company and distribute it in Mill Hall.

St. Matthews, S. C.—See "Power Plants, Gas and Electricity."

Mitchell, S. D.—It is reported that J. G. Markham, City Aud., will receive bids until Jan. 1 for a 2,000,000-gal. and a 1,500,000-gal. horizontal cross compound condensing Corliss crank and flywheel pumping engine.

Dallas, Tex.—The probable cost of installing a large service pump at the Turtle Creek pumping station and a building to house all the machinery will be about $204,000. J. M. Bassett, Ch. Engr. Water Wks.

Murray, Utah.—It is proposed to construct water works here at a cost of about $15,000. A pumping plant is to be installed as part of the system. Engineers undecided whether to use centrifugal or plunger pumps. Pumps will operate against a head of 125 lbs. and deliver a maximum of 500 gals. per minute. R. E. Caldwell, of L. D. S. University, Salt Lake City, is engineer in charge of the work.

**Salt Lake City, Utah.*—The following are reported to be the bids opened on Dec. 8 by the Bd. of Pub. Wks. for the construction of a brick and concrete conduit along the line of Salt Lake and Jordan Canal from S. Temple and 3d East St. to 5th South and 9th East Sts.: Hamley & Ritchie, of Topeka, Kan., $13,662 (awarded contract); Utah Fireproofing Co., $13,840; Showell Bros. & Belcher, $14,670; P. P. Moran, $17,386; A. P. Mickelson, $16,402 and Snow & Sherrill, $15,995.

Richmond, Va.—Local press reports state the Water Com. on Dec. 14 rejected the bid of the Crouse Constr. Co., of Perth Amboy, N. J., for building the conduit to the settling basin and work will probably not be started until the spring or summer.

Chatham, Va.—The citizens are reported to have voted to issue $7,500 bonds for increasing the water supply, for sidewalks, etc.

Milwaukee, Wis.—City Engr. Poetsch is reported to have recommended the installation of a 20,000,000-gal. pump for the water works.

Seattle, Wash.—Supt. Youngs, of the Water Dept., and City Engr. Thompson are reported to have selected a site in Woodland Park for a new water storage reservoir, to have a capacity of 50,000,000 gal., to cost about $200,000.

Bids will be received until Dec. 30 by the Bd. Pub. Wks. (C. B. Bagley, Secy.) for constructing water mains, grading, curbing and constructing concrete sidewalks on several streets. Estimated cost, $12,400.

Ballard, Wash.—Mayor Zook is reported to have authorized the Street Committee of City Council to take up the question of securing Cedar River water from Seattle. If no satisfactory arrangement can be made the Council will take steps toward securing an independent supply and may install a system of its own.

Seattle, Wash.—See "Power Plants, Gas and Electricity."

Roslyn, Wash.—W. P. Morgan, Mayor, writes in regard to the construction of water works that the matter has been discussed by the city authorities informally, and may at a later date be given attention.

Waitsburg, Wash.—The Council is reported to have decided to install a gravity filtration plant at a cost of $9,000.

Rainy River, Ont.—F. A. Gormley, Town Clk., writes that the proposed water works will cost about $33,000.

Chihuahua, Mex.—Bids will be received until Jan. 15 at the Municipal Palace, Hidalgo del Parral, Chihuahua, for the construction of water works and a sewerage system, as advertised in The Engineering Record.

SEWERAGE AND SEWAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Texarkana, Ark.—Bids will be received until Jan. 15 by the Bd. Pub. Improv., Dist. No. 5 (A. W. Stevens, Chmn.) for constructing a system of pipe sewers for said Dist., requiring about 11,385 ft. 6-in., 2,424 ft. 8-in., 2,252 ft. 10-in., and 4,582 ft. 12-in. pipe.

Cloverdale, Cal.—T. B. Wilson, Town Clk., writes that the citizens have voted to issue $18,000 bonds for the construction of a sewerage system.

San Jose, Cal.—Roy E. Walter, City Clk., writes that the citizens voted Dec. 12 to issue $355,000 bonds for new sewers, parks and school improvements.

San Francisco, Cal.—The Bd. of Pub. Wks. is reported to have prepared recommendations to be forwarded to the Bd. of Supervisors, for the construction of a bond sewer in 7th and Market Sts., at a cost of $22,000.

Nampa, Idaho.—See "Water."

**Chicago, Ill.*—Local press reports state that Nash Bros., 84 La Salle St., have secured the contract for constructing the 95th St. sewerage system, Sections 1 to 5, to include building machinery, iron pipe and sewers, for a total of $871,997 (bids opened Dec. 5). For list of bids received for this work see issue of The Engineering Record, Dec. 16.

**Tulsa, Ind. Ter.*—N. J. Gubser, City Recorder, writes that E. T. Likes, who is now constructing the sewer mains, will receive the contract for constructing the lateral sewerage system at $45,000, in the event of the successful issuance of the bonds.

Osceola, Ia.—It is stated that a sewerage system with septic tanks is to be constructed here, at a cost of $6,000.

**Dorchester, Mass.*—D. F. O'Connell Co., Dorchester, is reported to be the lowest bidder for building Dorchester Brook sewer in Dorchester for the city of Boston (bids opened Dec. 18) for $30,974.

Everett, Mass.—Sewer bonds to the amount of $10,000 and $23,000 sidewalk bonds are reported sold.

Grand Rapids, Mich.—L. W. Anderson, City Engr., writes that plans have been prepared for the Soldiers' Home sewer. Bids for construction will probably be called for in February.

Hattiesburg, Miss.—See "Water."

Joplin, Mo.—The Council is reported to be considering the construction of a storm sewer.

New Brunswick, N. J.—It is proposed to construct sewers on Commercial Ave. and Bishop St. F. C. Schneider, City Engr.

Atlantic City, N. J.—The City Council is reported to have passed on second reading the ordinance granting permission to the Sewerage Co. to make a slight raise in the existing rates. The company proposes expending about $400,000 in improvements, including the changing of the sewerage system in Chelsea.

New York, N. Y.—Bids will be received until Dec. 28 by John F. Ahearn, Boro. Pres., for furnishing material and improving sewer and appurtenances in 39th St. and 11th Ave. Engineer's estimate: 864 lin. ft. wooden barrel sewer, 4 ft. diam.; 450 lin. ft. brick sewer, 4 ft. diam.; 73 lin. ft. brick sewer, 4 ft. diam.; 250 lin. ft. brick sewer, 4 ft. diam.; 42 lin. ft. brick sewer, 3 ft. 6 in. x 2 ft. 4 in.; 100 lin. ft. brick sewer, 3 ft. 6 in. x 2 ft. 4 in.; 50 lin. ft. salt glazed vitr. stoneware pipe culvert, 12 in.; 2 receiving basins (circular): 600 cu. yd. rock excav. and removed; 50 M. ft. B. M. timber and plank for bracing and sheet piling; also outlet sewer and appurtenances in W. 216th St. Engineer's estimate: 125 lin. ft. brick sewer, 5 x 4 ft.; 353 lin. ft. brick sewer, 5 x 4 ft.; 300 lin. ft. brick sewer, 4 x 2 ft. 8 in.; 279 lin. ft. brick sewer, 4 x 2 ft. 8 in.; 100 lin. ft. brick sewer, 3 ft. 6 in. x 2 ft. 4 in.; 260 lin. ft. brick sewer, 3 ft. 6 in. x 2 ft. 4 in.; 85 lin. ft. salt-glazed vitr. stoneware pipe culvert; 40 M. ft. B. M. timber and plank for bracing and sheet piling, etc.; also same date for reconstructing receiving basins and manholes in Delancey St. Engineer's estimate: 11 receiving basins (circular); 171 lin. ft. salt glazed vitr. stoneware pipe culvert, 12-in. diam.; 5 M. ft. B. M. timber and plank. for bracing and sheet piling; 19 side-chamber manholes; 8 old manholes to be taken down 4 ft., covered with 4-in. flag, etc.

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* *Items marked thus give the names of parties awarded contracts.*

Brooklyn, N. Y.—Bids will be received until Dec. 30 by Martin W. Littleton, Boro. Pres., for furnishing material and reconstructing a storm sewer in Nostrand Ave. Engrs. estimate: 472 lin. ft. 42-in. brick sewer 2 manholes, 12,000 ft. B. M. foundation planking, 40,000 ft. B. M. sheeting and bracing, etc.

The Bd. of Estimate on Dec. 18 authorized the expenditure of $49,200 for the construction of a sewer in 84th St., between 20th and 21st Aves., and in 21st Ave., between 84th St. and Benson Ave.

Waterford, N. Y.—John G. Cole, Supervisor, writes that it is proposed to macadamize Saratoga Ave. at a cost of $22,000, and plans will be prepared by the State Engineer at Albany. A sewer will also be constructed in connection with same at a cost of $23,000, plans for which will be prepared by Thos. F. Grattan, of Cohoes.

Swinburne Island, N. Y. H., N. Y.—Bids will be received by Fred H. Schroeder, Pres. Bd. Comrs. of Quarantine, 62 William St., N. Y. City, until Dec. 29, for the construction of sewers on Swinburne Island, as advertised in The Engineering Record.

Cincinnati, O.—Bids will be received until Dec. 27 by the Bd. Pub. Service (Geo. F. Holmes, Clk.) for furnishing material and constructing sewers in several streets.

Cleveland, O.—Bids will be received until Dec. 26 by the Bd. Pub. Service (A. R. Callow, Secy.) for constructing sewers in several streets.

**Akron, O.*—Hallinan Bros. are stated to have secured the contract to construct the South Akron sanitary sewer connecting Bowery St. and the vicinity north and east of Summit Lake at about $31,550; the contract for extending the Thornton and Voris St. sewers is stated to have been awarded to Hunt & Wigley, at $3,826.

South Charleston, O.—Bids will be received until Dec. 28 by W. L. Wentz, Village Clk., for furnishing material and constructing a tile and sewer drain.

**Pittsburg, Pa.*—M. O'Herron & Co., S. 1st and Keen Sts., has secured the contract for constructing sewers in Asbury Pl., Elizabeth, Fingel, Jansey, Nantasket and Uvila Sts. (bids opened Dec. 13) for $13,184.

Bridgeport, Pa.—The citizens will probably be asked to vote in the spring on the issue of $25,000 bonds for the construction of a system of storm and sanitary sewers.

Erie, Pa.—B. E. Briggs, City Engr., writes in regard to the issuing of $270,000 bonds for intercepting sewers, bridges and garbage disposal plant, that the proposition has been postponed for the present.

Roanoke, Va.—The citizens are reported to have voted Dec. 12 to issue $100,000 bonds for sewers.

Centralia, Wash.—It is reported that surveys are being prepared for a sewerage system.

Chihuahua, Mex.—See "Water."

BRIDGES.

Notes Arranged Alphabetically by States.

Red Bluff, Cal.—The Bd. of Superv. is stated to have decided to award the contract for constructing an additional span to the county bridge over Thomas Creek on the Corning Road to Paul & McCartney, for $4,200.

Washington, D. C.—The Senate Com. of the Dist. of Columbia is stated to have reported favorably on the construction of a memorial bridge from the Naval Observatory Grounds across the Potomac River to Arlington at a cost of $5,000,000. It is stated that $500,000 is appropriated to secure plans for constructing the bridge.

Peoria, Ill.—The City Council is stated to have decided to accept the proposition of Wm. McKinley to construct a railroad bridge over Illinois River at either Bridge or Walnut Sts., at a probable cost of $300,000.

Lyndon, Kan.—It is stated that bids will be received until Jan. 2 by the Bd. Co. Comrs. for constructing steel bridges, as follows: one 102 ft., one 42 ft. and two, each 100 ft. long, all with 14-ft. roadway on stone abutments. John W. Yeomans, Co. Clk.

Oberlin, Kan.—It is stated that bids will be received until Jan. 3 by the Bd. Co. Comrs., for constructing 6 steel bridges in Decatur Co. L. F. Campbell, Co. Clk.

**Boston, Mass.*—The following are the bids opened on Dec. 15 by the Cambridge Bridge Comn., at Boston, for building Cambridge abutment and wing walls for Cambridge Bridge at Cambridge: H. A. Hanscom, Boston, Mass., $50,123; Lawler Bros., Charlestown, Mass., $39,974; D. F. O'Connell Co., Dorchester, Mass., $39,017; Wm. L. Miller, Boston, Mass., $36,911; Wm. Crane, Boston, Mass., $35,247; Patk. McGovern, Boston, Mass., $34,201; Wm. H. Ellis, Boston, Mass., $33,386, and Holbrook, Cabot & Rollins, Tremont Bldg., Boston, $31,188 (awarded contract).

Minneapolis, Minn.—See "Railroads."

Blue Earth, Minn.—Bids will be received until Jan. 3 by the Bd. Co. Comrs. for furnishing material and constructing a steel bridge on steel piers across the Blue Earth River in the township of Winnebago City, to have 1 span 90 ft. long, width of roadway 16 ft.; also 2 steel approaches, each 16 ft. long. G. B. Franklin, Co. Aud.

Kansas City, Mo.—See "Miscellaneous."

**Omaha, Neb.*—The County Comrs. are stated to have awarded the contract for constructing a bridge over the Pappio on the Center St. Road to the Canton Bridge Co., of Canton, O., for $4,900.

New York, N. Y.—The Bd. of Estimate and Apportionment approved the resolution providing for the issue of $115,000 corporate stock for constructing a bridge over Mosholu Parkway drive and approaches in Boro. of Bronx. The bridge is in connection with extension of Jerome Ave.

Sandy Hill, N. Y.—E. H. Snyder, of Argyle, Clk. of Washington County, writes that the Union Bag & Paper Co., of Sandy Hill, or Robt. Law, Clk. of the Bd. of Superv. of Cambridge, N. Y., are interested in the erection of a bridge over Hudson River between Sandy Hill and Fennimore, to cost $60,000.

Comstock, N. Y.—See "Railroads."

Pembina, N. D.—Bids will be received until Jan. 15 by Swain Thorwaldson, Co. Aud., for furnishing material and constructing a steel bridge across Pembina River, commonly known as "Hughes Bridge."

Cleveland, O.—The City Council is stated to have adopted a resolution directing the City Engineer to prepare plans for a high-level bridge connecting Huron and Lorain Sts.

Akron, O.—It is stated that bids will be received until Jan. 8 by M. D. Buckman, Co. Aud., for constructing a bridge over the Akron & Barberton R. R.

Erie, Pa.—See "Sewerage and Sewage Disposal."

**Monessen, Pa.*—The American Bridge Co., 42 Bway., New York, N. Y., is stated to have received the contract for constructing superstructure of a combined highway and railroad bridge consisting of 2 spans each 400 ft. long over Monongahela River for the Mercantile Bridge Co.

Huron, S. D.—Bids will be received until Jan. 10 by L. C. Burney, Co. Aud., for constructing all bridges required for the ensuing year, as may be ordered by the Bd. Co. Comrs.

**Chattanooga, Tenn.*—The contract for rebuilding 8 bridges between Helenwood and Oakdale is stated to have been awarded by the Queen & Crescent Route to the American Bridge Co., 42 Bway., New York, N. Y., for $250,000.

Milwaukee, Wis.—The following are the bids opened Dec. 15 by the Bd. of Pub. Wks. for the construction of the superstructure of Washington Ave. viaduct: American Bridge Co., Milwaukee, $137,500; Worden Allen Co., Milwaukee, $129,975; Stroebel Steel Constr. Co., $91,510, and F. W. Moore (4 bids), $111,575 to $124,750.

Sheboygan, Wis.—The Widell-Finley Co. is stated to have received the contract for constructing a bridge over the river for the Chicago & Northwestern Ry. Co. for $100,000, the railway company furnishing the material.

PAVING AND ROADMAKING.

Notes Arranged Alphabetically by States.

San Francisco, Cal.—The Board of Supervisors will receive bids on Jan. 8 for $324,000 bonds to be used for repaving streets in the business section of the city.

San Francisco, Cal.—Press reports state that bids will be received until Dec. 27 by the Bd. Pub. Wks., for repaving portions of 4th, Mission and Minna Sts. with basalt block; also Mission Road with asphalt; probable cost, about $61,250.

Jacksonville, Fla.—Bids will be received by the Bd. Pub. Wks., until Jan. 22, for grading, curbing and paving King St. with vitr. block, about 1,360 sq. yds. Philip Prioleau, City Engr.

Everett, Mass.—See "Sewerage and Sewage Disposal."

Hattiesburg, Miss.—See "Water."

Kansas City, Mo.—The Bd. of Pub. Wks. is stated to have decided to pave 15th St. for a distance of 8,000 ft.

Independence, Mo.—Press reports state that the Co. Clk. will receive bids until Jan. 10 for grading Blue Springs and Tarsney Roads; also macadamizing the Lee Summit and Greenwood Roads.

Troy, N. Y.—The Montgomery County Bd. of Supervisors is reported to have approved plans for macadamizing the following roads at a cost of $217,700: Amsterdam-Fort Hunter and Amsterdam-Morris Corners, Akin to Johnstown, Tribes Hill to Fulton County line, Berryville-Yosts and Glen-Charleston Roads.

Syracuse, N. Y.—The following are the bids opeend on Dec. 18 by the Board of Contract and Supply for paving with natural asphalt: (*a*) Tully St.; (*b*) Highland St.; (*c*) Park Ave., with sheet asphalt: Warren Asphalt Paving Co., *a* $20,548, *b* $7,682, *c* $9,168; Central City Paving Co., *a* $20,071, *b* $7,857, *c* $9,339; F. J. Baker, *a* $21,684, *b* $7,357, *c* $9,540; Warner-Quinlan Co., *a* $21,411, *b* $7,679, *c* $8,666.

A resolution providing for the improving of the Liverpool Plank Road, between Syracuse and Liverpool, is reported to have been adopted by the Bd. of Superv.

Resolutions for the improvement of sections of the toll roads in the town of Manlius are reported also adopted. The roads are between Manlius and Fayetteville, about 2 miles; Minoa to Fayetteville, about 4½ miles; on the Genesee turnpike west of Fayetteville, about one mile, and about a mile on the same road running east of Fayetteville.

Waterford, N. Y.—See "Sewerage and Sewage Disposal."

New York, N. Y.—The Bd. of Estimate is stated to have appropriated $100,000 toward the extension of Riverside Drive at 181st St.

**Brooklyn, N. Y.*—The Brooklyn Alcatraz Co., 12th St. and Gowanus Canal, has secured the contract for regulating, grading, curbing, guttering and laying sidewalks on 86th St., from 5th to 13th Ave. (bids opened on Dec. 13 by Martin W. Littleton, Pres. Brooklyn Boro.). It bid for 8,343 cu. yds. earth excav., 25 cts.; 7,966 lin. ft. combined concrete curb and gutter, 69 cts., and 30,170 sq. ft. cement sidewalk, 15 cts.; total, $12,108. The other bidders were: Norton & Gorman, 303 Douglass St., $15,783; Danl. Douglass, 122 Logan St., $19,258; J. T. Rutan, 4 and 5 Court Sq., $14,509; Chas. Cranford, 44 Court St., $13,009; Dominick Bonacci, 220 4th Ave., $13,154; Murphy Bros., 25th Ave. and Cropsey Ave., $14,349, and N. Schneider's Sons, 144 21st St., $13,382 (bidders all of Brooklyn).

Watertown, N. Y.—It is stated that the Alexandria Bay Clayton Boulevard Co. is incorporated to construct and maintain a boulevard 12 miles in length between Clayton and Alexandria Bay. R. P. Grant is reported interested.

Buffalo, N. Y.—The Bd. of Superv. is reported to have decided to appropriate $281,000 toward the construction of 56 miles of good roads in Erie County.

**Cincinnati, O.*—The following are the bids opened Dec. 12 by the Bd. of Pub. Service for paving Spring Grove Ave. with bitulithic pavement: (*a*) Warren Bros. Co.; (*b*) Kirchner Constr. Co. (awarded contract); (*c*) Henkel & Sullivan:

	a	**b*	*c*
2,050 lin. ft. curbs, 5-in. granite	$1.30	$1.30	$1.25
60 lin. ft. curbs., 5-in. granite circular	2.20	2.15	2.20
3,500 cu. yds. excavation	.40	.30	.40
5,650 sq. yds. finished grading and rolling	.10	.10	.10
50 cu. yds. extra stone	1.70	1.75	1.75
1,180 cu. yds. crushed stone foundation	2.20	2.20	2.10
50 cu. yds. Portland cement concrete	5.00	6.00	5.00
7,070 sq. yds. furnish. and pour foundation with bitumen	.25	.18	.20
7,070 sq. yds. wearing surface and binder	1.53	1.40	1.60
7,070 sq. yds. stone chips finished surface	.10	.08	.10
7,070 sq. yds. bituminous flush coat	.15	.10	.15
7,070 sq. yds. for patent rights	.25	.25	.25
10 cu. yds. brick masonry	8.25	8.00	7.50
150 lin. ft. drain pipe 12-in	1.10	1.00	.75
3 pieces Palmer traps	6.00	7.00	6.00
10 pieces granite drip stones	5.00	5.00	5.00
3,630 lbs. castings	.05	.05	.05
320 sq. yds. granite crossings	3.50	3.60	3.75
Total	$25,430	$23,238	$23,373

Bids will be received until Dec. 27 by the Bd. Pub. Service (Geo. F. Holmes, Clk.) for improving a portion of Josephine St. by paving with bitulithic, and a portion of E. 3d St. by paving with granite blocks.

Columbus, O.—The grading and curbing of 2d Ave., from Railroad St. to the north city limits, including the construction of a viaduct of granite or reinforced concrete arch across Cook branch, is reported under consideration; probable cost, $15,000.

Bucyrus, O.—City Engineer Chas. Bryant is stated to have estimated the cost of paving Lucas St. at $14,310.

Cleveland, O.—Bids will be received until Jan. 10 by the Bd. Co. Comrs. (Julius C. Dorn, Clk.) for the completion of the North Woodland Road Macadam. Wm. H. Evers, Engr., 237 The Arcade.

**Toledo, O.*—The contract for paving with Metropolitan block on broken stone foundation a portion of E. B'way and Oswald St. is reported to have been awarded to Garrigan Bros., Valentine Bldg., for $14,481.

Toledo, O.—Bids will be received until Dec. 26 by the Bd. Pub. Service (Harry S. Jones, Secy.) for furnishing material and improving a portion of 10th St., Whitney and Madison Aves., by paving with either vitrified paving block, asphalt block, sheet asphalt, Medina block stone, creosoted wood blocks, bitulithic or other bituminous macadam on a foundation of broken stone or vitrified paving blocks, asphalt blocks or Medina block stone.

Cincinnati, O.—The lowest bid opened on Dec. 12 by the Bd. of Pub. Service for paving Chatham St. with brick, was submitted by E. S. Gleason, of Cincinnati, for $3,779.

**Akron, O.*—E. McShaffrey & Son are stated to have received the contract for paving with brick Lods St., for $10,665.

North Braddock, Pa.—Bids will be received until Dec. 28 at the office of C. A. Stewart, Boro. Engr., for improving Wood Alley by paving with brick, about 2,250 sq. yds.

**Pittsburg, Pa.*—The Barber Asphalt Paving Co., Arrott Bldg., has secured the contract for paving with sheet asphalt on Auburn and Chancer Sts., Avondale Pl., and Braden, Hamilton, Hector and Murray Aves., for a total of $35,099.

New Brighton, Pa.—Bids will be received by the Town Council until Dec. 28 for paving 11th Ave. with vitrified clay block, about 7,800 sq. yds., as advertised in The Engineering Record.

Hazelton, Pa.—The Common Council is stated to have passed ordinances providing for the issuing of $35,000 bonds for street paving; also appropriating $18,000 for paving E. and W. Broad Sts.

San Antonio, Tex.—The citizens voted Dec. 12 to issue $120,000 bonds for improvements to consist of the construction of storm water sewers, about 1 mile of macadam and 32,000 sq. yds. brick paving on concrete foundation. John D. Rullman, City Engr.

Roanoke, Va.—The citizens are reported to have voted Dec. 12 to issue $175,000 bonds for street improvements.

**Seattle, Wash.*—The Barber Asphalt Co. has secured the contract for the improvement of Prefontaine Pl. and other streets (bids opened Dec. 2) for $107,577. For list of bids received for this work, see issue of The Engineering Record, Dec. 16.

Seattle, Wash.—See "Water."

Seattle, Wash.—Bids will be received until Dec. 30 by the Bd. Pub. Wks. (C. B. Bagley, Secy.) for paving with asphalt Westlake Ave; est. cost, $40,000.

**Brooklyn, N. Y.*—The following are the bids opened Dec. 13 by Martin W. Littleton, Pres. Brooklyn Boro., for regulating and repaving with asphalt block pavement on a concrete foundation Livingston St. from Court St. to Flatbush Ave.: (*a*) Hastings Pavt. Co., 25 Broad St., N. Y. City; (*b*) Brooklyn Alcatraz Co., 12th St. and Gowanus Canal, Brooklyn (awarded contract); (*c*) Chas. Cranford, 44 Court St., Brooklyn; (*d*) Barber Asphalt Paving Co., 114 Liberty St., N. Y. City.

	a	**b*	*c*	*d*
10,820 sq. yds. asphalt block pavt	$1.49	$1.20	$1.60	$1.84
200 sq. yds. adjacent pavt	.30	.30	.30	.30
1,600 cu. yds. concrete	5.44	4.25	4.50	3.87
6,070 lin. ft. new curb	.84	.85	.82	.82
600 lin. ft. old curb reset	.35	.30	.30	.33
47 noiseless covers and heads, complete, for sewer manholes	15.00	15.00	15.00	14.00
89,100 sq. ft. cement sidewalk	.15	.15	.15	.15
25 sewer catch-basins	60.00	125.00	65.00	45.00
Totals	$46,254	$42,761	$45,829	$46,832

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* *Items marked thus give the names of parties awarded contracts.*

POWER PLANTS, GAS AND ELECTRICITY.

Notes Arranged Alphabetically by States.

Dothan, Ala.—Bids are wanted until Jan. 1 for a franchise for a gas plant. Each bid must guarantee the laying of 2 miles of mains in not less than 6 in. main pipe in 18 months. R. W. Lisenby, Town Clk.

Enterprise, Ala.—The Enterprise Power & Light Co., of Enterprise, is reported incorporated with a capital of $20,000, by J. P. Rouels, O. C. Doster, Jr., and others.

Anniston, Ala.—The Coosa River Electric Power Co. has been incorporated, with principal office at Room 937, First National Bank Bldg., Birmingham, and a capital of $100,000, to develop and utilize the natural water power of Coosa River at Ten Island Shoals, by building a dam, power house and transmission lines to Anniston, Gadsden, Attalla, Alabama City, Pell City, Riverside and other cities. R. H. Cobb, Vice-Pres., Anniston.

Argenta, Ark.—Bids will be received until Jan. 15 by C. J. Humphreys, Secy. Board of Improv., Improv. Dist. No. 1, for furnishing all the material required in the construction of the water works and electric light plant for said city. O'Neil Engr. Co., Engrs., 506 North Texas Bldg., Dallas, Tex.

Pomona, Cal.—J. E. Adamson, of Pomona, is reported to have prepared plans for a power plant for the Ontario Power Co.

San Bernardino, Cal.—The Mill St. power plant of the San Bernardino Electric Co. is reported to have been destroyed by fire.

Needles, Cal.—Danl. Murphy, of Los Angeles, is reported interested in the construction of a power plant at Needles, to furnish light and power to the town and mines.

Greeley, Colo.—J. J. Hendrie, of Denver, is reported to have filed a petition with the County Comrs. for a 50-yr. franchise over the county roads for poles, wires, etc. It is stated that a power plant will probably be constructed at Lafayette or Louisville and transmission lines constructed from there to Greeley, Windsor, Ft. Collins, Cheyenne and Denver.

Washington, D. C.—Bids will be received until Jan. 2 at the Bureau Supplies and Accounts, Navy Dept., Washington, to furnish at the navy yards, Boston, Mass.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., a quantity of naval supplies, as follows: Schedule 285, panel boards, cable, conduit and fittings; electrical supplies; iron pipe and fittings. Schedule 286, incandescent lamps; testing generators; volt meters, etc. Schedule 287, pig iron, etc. Schedule 288, electrical wire; bar iron; white pine, etc. Applications for proposals should designate the schedules desired by number. H. T. B. Harris, Paymaster-Gen., U. S. N.

Lake City, Fla.—J. C. Sheffield, Chmn. Bd. Pub. Wks., writes that bids will probably soon be called for a $15,000 addition to the electric light plant.

Rome, Ga.—The City Council is reported to have granted franchises to the Etowah Power Co., which will construct a plant at Cartersville, and to the Little River Power Co., whose power plant will be on Lookout Mountain, 30 miles from Gadsden.

Brunswick, Ga.—It is reported that much of the machinery at the plant of the Mutual Light & Water Co. has been damaged by fire.

Elgin, Ill.—Anson B. Root, Pres. Elgin Hydraulic Co., is reported to have decided to organize the Elgin Hydraulic Heat, Power & Light Co., for the purpose of making and supplying electricity in this city.

Lewistown, Ill.—The Fisher Power, Heat & Electric Lighting Co., of Lewistown, is reported incorporated with a capital of $20,000, by Floyd M. Condit, Theo. Fisher and H. W. Masters.

Lockport, Ill.—Bids will be received until Jan. 17 (extension of date) by the Bd. Trus. Sanitary Dist., Chicago (S. D. Griffin, Clk.) for constructing a canal lock, movable dams and fender wall in connection with the water power development now being made near Lockport.

Albia, Ia.—W. C. Mentzer is reported to have decided to construct a gas plant at Albia.

Havre de Grace, Md.—The Town Council is reported to have granted to Grant Richwine a franchise to establish a gas plant and lay gas mains.

Westboro, Mass.—The Westboro Gas & Electric Light Co. is reported to have petitioned Selectmen for a franchise to pipe gas through Westboro.

St. Joseph, Minn.—The Sisters of the Order of St. Benedict are reported to have secured a franchise for an electric light plant. It is proposed to install the plant at St. Benedict's Academy and furnish the village, also private consumers, with electricity.

Hattiesburg, Miss.—The City Council has granted a 25-year gas franchise to N. B. Blount, J. B. Burkett and others, all of Hattiesburg.

Wood River, Neb.—It is reported that plans and specifications are being prepared for water works and a lighting plant.

Creighton, Neb.—The citizens are reported to have organized a stock company, with a capital of $25,000, for the purpose of installing an electric light plant.

Little Falls, N. J.—The Township Com. is reported to have granted a franchise to the Economy Electric Light, Heat & Power Co. C. H. Belding and W. G. Van Ness are reported interested.

Albuquerque, N. M.—The Rio Grande Land, Water & Power Co. is reported incorporated with a capital of $1,000,000 by A. W. Hoffman, W. B. Childer and others, all of 117 W. Gold St.

Whitehall, N. Y.—The local electric light company is reported to be considering the construction of a gas plant.

Batavia, N. Y.—The Genesee County Electric Light, Power & Gas Co. is reported to have petitioned the State Gas Comn. for permission to increase its capital from $100,000 to $250,000. If granted, steps will be taken to distribute electricity in various towns in Genesee County.

New York, N. Y.—Bids will be received until Dec. 28 by John F. Ahearn, Pres. Manhattan Boro., for furnishing 5 electric light fixtures for the Governor's rooms in the City Hall. Bernstein & Bernstein, Archts., 24 E. 23rd St.

Brooklyn, N. Y.—Bids will be received until Jan. 2 by C. B. J. Snyder, Supt. School Bldgs., New York City, for installing electric equipment in new School 151, Boro. Brooklyn.

Union, N. Y.—A. Ray Humphrey, Village Clk., writes that H. B. Sweet, of Utica, is engineer for the proposed electric light plant, which will cost about $15,000.

Troy, N. Y.—The Special Com. appointed by the Bd. of Superv. to report on the cost of erecting a county electric lighting plant for the various county buildings has submitted a report, and estimates the cost of a central plant to be erected on the County House of Industry property with wire connections with the other buildings as follows: erecting plant complete, including poles and wires, $16,136, the cost of maintenance being $9,346 per yr. The cost of erecting separate plans was estimated as follows: County House, $2,670; Court House, $1,700; armory, $2,900; county jail, $1,400; total cost of maintenance, $7,732.

Shawnee, Okla.—The probable cost of work contemplated by the Shawnee Gas Light Co. (T. P. Stearns, Vice-Pres.) is reported to be $100,000. Mainland Bros., of Oskhosh, Wis., are the owners.

Portland, Ore.—Wm. B. Chase, of Portland, Ch. Engr. Cascade Power Co., writes that the proposed power plant will be located about 50 miles from Portland, the water to be developed to be taken from Zig Zag, Still and Camp Creeks, to furnish about 30,000 h.p.; cost of proposed work about $650,000.

**Philadelphia, Pa.*—The Philadelphia Electric Co. is reported to have secured the contract for lighting the streets by electricity for the year 1906, for a total of $1,073,272.

Pittsburg, Pa.—The Chemical Light, Heat & Power Co., of Pittsburg, is reported formed with Thos. McWatters, Times Bldg., as mgr., to construct a plant at Beaver Falls, to cost about $200,000. This company is reported to have taken over the plant of the Wooster Gas Light Co., of Wooster, O., the plant of the McWatters By-Products and Gas Mfg. Co., at Beaver Falls, and will take over four other gas and electric light plants in Ohio and Pennsylvania.

St. Matthews, S. C.—It is reported that an election will probably soon be held to vote on issuing $20,000 bonds for water works and an electric light plant.

Aberdeen, S. D.—It is stated that $35,000 municipal light bonds have been sold.

Salt Lake City, Utah.—Chas. W. Johnson, 354 S. 7th West St. is reported to have filed application at the State Engineer's office for ten second-feet of water from Puffer Lake for power purposes. The diverting channel is to consist of a tunnel 3 ft. wide and 5 ft. high. From the tunnel a pipe line will be constructed a distance of 15,000 ft. to where the power plant will be constructed. The power will be used for lighting and propelling machinery in Marysvale and Kimberly.

Prosser, Wash.—The County Comrs. are reported to have granted the Prosser Falls Land & Title Co. (John Chisholm, Supt., Prosser) a franchise to construct a power line along the county road to the western boundary for the purpose of transmitting electric power to Sunnyside.

North Yakima, Wash.—W. A. Aldrich, of Spokane, Gen. Mgr. Spokane Falls Gas Co., writes that the Yakima Gas Co. will construct a gas plant at North Yakima, at a cost of $40,000. Bids for construction will be called for early in the new year.

Seattle, Wash.—M. B. Haynes, 15 Scheuerman Blk., writes that the name of the Priest Rapids Irrigation & Power Co. has been changed to the Hanford Irrigation & Power Co. It is proposed to pump water for irrigation from Columbia River; probable cost of work contemplated $340,000. Bids for construction will be received about Jan. 15. Engineer, H. K. Owens, Alaska Bldg.

Montreal, Que.—The Jamaica Light & Power Co., of Montreal, Que., it is stated, has been incorporated at Ottawa, Ont., with a capital of $250,000. Incorporators: Jas. Hutchinson, C. J. Fleet, of Montreal; G. W. Webster, of Westmount, and others.

ELECTRIC RAILWAYS.

Notes Arranged Alphabetically by States.

Los Angeles, Cal.—It is stated that the Los Angeles-Pacific Ry. Co. (E. P. Clark, Mgr.), according to reports, is making active preparations to standardize its entire system in and out of Los Angeles, comprising several hundred mile of narrow-gage track. The company proposes to issue about $10,000,000 bonds, part of the proceeds of which will be used for this purpose and part for the extension and perfection of its various tributary lines and local systems in San Monica and Ocean Park.

San Francisco, Cal.—The Board of Superv. is stated to be considering the ordinance granting the Ocean Shore Ry. Co. a franchise to construct an electric railway from Army and Vermont Sts., where its main line is to be located, over certain streets, and terminating at 12th and Market Sts. The ordinance will be transmitted to the City Engineer in the meantime for the fixing of grade changes required along the route of the proposed system.

San Diego, Cal.—It is reported that E. S. Babcock is to parallel the San Diego Electric St. Ry. system here.

Ft. Wayne, Ind.—The Ft. Wayne & Wabash Valley Traction is reported to have engineers in the field making preliminary survey for its extension from Logansport to Lafayette, to be built in the early spring.

Laporte, Ind.—It is stated that the contract has been awarded to the John R. Lee Constr. Co., of New York, N. Y., to build an electric railway from Laporte to South Bend for the Chicago, Lake Shore & South Bend Ry. Co., an enterprise promoted by Edwin Hanna, of Cleveland, O.

Evansville, Ind.—The Vanderburg & Posey Electric Ry. Co. is reported to have filed articles of incorporation with the Secretary of State. Capital, $10,000. The purpose is to build an electric railway between New Harmony and Evansville and between Evansville and Mt. Vernon. C. F. Martin, E. B. Bixler, J. A. Higgins and Frank Emerson are the incorporators.

Indianapolis, Ind.—The Indiana Rapid Transit Co. is reported incorporated, with a capital of $50,000, to build a road to connect Indianapolis, Terre Haute, Crawfordsville, Frankfort, Kokomo, Logansport, Plymouth and South Bend. Incorporators: P. M. Dunn, A. M. Weeden, I. G. Besler, and others.

The Indianapolis, New Castle & Toledo Traction Co. is reported to have announced that the road has been financed, and that the contract will be let at once and the road speedily constructed. Chas. S. Hernley, Secy.

Oskaloosa, Ia.—The Oskaloosa & Buxton Electric Ry. Co. is reported to be securing right of way for its proposed line between Oskaloosa, Beacon, White City and Buxton, work on which will be begun early next spring. The line will be 18 miles long, standard gage, and will be equipped with the overhead trolley. Harry E. O'Neill, Pres. and Gen. Mgr.; C. E. Lofland, Secy.; Geo. Kalback, Treas., all of Oskaloosa.

Boston, Mass.—The construction of an air line electric railway between Lowell and Boston is reported under consideration. Oakes Ames, of Easton, and Chas. F. Remington and others are reported interested.

Port Huron, Mich.—It is reported that the Grand Trunk Ry. Co. has taken a decisive step in the matter of equipping the St. Clair tunnel with electric motive power and that a contract has been let involving an expense of $680,000.

St. Louis, Mo.—It is stated that surveys are being made for the St. Louis, Hillsboro & Southern Electric Ry., from St. Louis to Richwoods, a distance of 60 miles. The company is reported incorporated with a capital of $1,250,000. R. E. Williams, Pres.; H. D. Brandt, Secy.; L. D. Winter, Treas., and H. M. Bowen, of Alton, Ill., Gen. Mgr.

Red Bank, N. J.—The Atlantic Coast Electric Ry. is reported incorporated with $1,000,000 capital. Incorporators: Chas. L. Spier, Wm. Evarts, Benj. and H. H. Rogers.

Niagara Falls, N. Y.—The International Ry. Co. is stated to have been granted a franchise for the extension of certain lines in this city.

Madison, N. Y.—A franchise to construct a street railway on certain portions of the highway of Madison is reported to have been granted. The plan is to build from Clinton to Hamilton, and it is understood that the necessary consents and private right of way for the 25 miles of road have been almost all secured. Thos. F. McBride is reported interested.

Fairport, N. Y.—The State Canal Board on Dec. 19 granted the application of the Rochester, Syracuse & Eastern Ry. Co. (Theo. H. Mather, Ch. Engr., Syracuse) to construct and operate a double-track railway across Erie Canal in Fairport.

Binghamton, N. Y.—It is stated that the Erie R. R. Co. (Francis Lee Stuart, Ch. Engr., New York) has prepared plans for constructing an electric railway from Binghamton to Corning, a distance of 76 miles. The new line will parallel the present line of the Erie R. R. Surveys for the proposed road will be made immediately and contracts for construction will probably be let in January.

Bristol, Va.—It is stated that bids will be received for a street railway franchise by the City Council until Jan. 2.

Morgantown, W. Va.—W. W. Smith, of Morgantown, Attorney and Secy. of the Morgantown-Dunkard Valley R. R. Co., writes that bids will probably be received in February for the construction of an electric railway about 42 miles in length; cost of construction, including power plant, will be about $500,000. Engineer, Prof. C. R. Jones. D. C. Hoffman and L. L. Thomas are also interested.

RAILROADS.

Notes Arranged Alphabetically by States.

Peru, Ill.—The Peru, La Salle & Deer Park R. R. Co. has been incorporated to construct a line from Peru to Deer Park; capital, $100,000. Incorporators: Thos. F. Noon and Chas. F. Neureuther, Peru, Ill.; Winfield S. Clow, of La Salle, Ill., and others.

Oberlin, Kan.—The Chicago, Burlington & Quincy R. R. Co. (W. L. Breckenridge, Ch. Engr., Chicago, Ill.) is reported to have filed articles of incorporation for the Beaver River & Denver Ry. Co., to construct a line from Oberlin, Kan., branch to the Atwood, Kan., branch of the Burlington, and from St. Francis, Kan., to the Denver-Omaha main line; capital $400,000.

Armourdale, Kan.—The Chicago, Rock Island & Pacific R. R. Co. (D. E. Cain, mgr., Topeka, Kan.) is reported to have decided to expend about $100,000 in rebuilding its yards here. After new yards are completed it is proposed to rebuild the old yards, build new roundhouse and coal chutes.

Baltimore, Md.—According to local press reports the probable cost of elevating the tracks of the Baltimore & Ohio R. R. Co. (D. D. Carothers, Ch. Engr., Baltimore, Md.) in South Baltimore, will be about $2,000,000.

**Lynn, Mass.*—M. McDonough, of Swampscott, is reported to have secured the contract for grading track and roadway between Lynn and Salem, for the Boston & Northern St. R. R. Co., of Boston. Cost about $55,000.

Minneapolis, Minn.—Preliminary plans for the elevation of the Milwaukee tracks from 3rd Ave. S to Southtown Junction, are reported to have been submitted to Council Com. on grade crossings by City Engineer Andrew Rinker. The right of way is about 6,000 ft. long, with an average width of 65 ft. Fully ¼ of the right of way is across streets, necessitating about 20 bridges or viaducts. The engineer figures that the tracks can be raised 9 ft., which will mean a cut in the streets at the lowest point of 5 or 6 ft. The fill will require 2,632,500 cu. yds. of earth.

Newport, Neb.—The Midland Central R. R. Co. is reported incorporated, with a capital of $500,000, by E. L. Myers, C. M. Thompson, C. A. Ripley and others. The road will be about 170 miles long, and will extend from Spalding through Greeley, Wheeler, Holt, Rock and Keya Paha Counties, to Springview. Principal office at Newport.

Madison, N. J.—Messrs. Redmond and Anderson are stated to have been appointed to act with the Mayor as a committee to confer with the Delaware, Lackawanna & Western R. R. Co. (L. Bush, Ch. Engr., Hoboken) in regard to the elevating of the railroad tracks.

**Atlantic City, N. J.*—The General Electric Co., of Schenectady, N. Y., is reported to have secured the contract for equipping the Atlantic City branch of the Pennsylvania R. R. with electricity for about $3,000,000.

** Items marked thus give the names of parties awarded contracts.*

Trenton, N. J.—The Pennsylvania R. R. Co., through its president, A. J. Cassatt, and other officials, is reported to have filed articles with the Secretary of State incorporating the Pennsylvania & Newark R. R. Co.; capital, $500,000. The company is to construct and maintain a railroad from a point on Delaware River at Trenton through the counties of Mercer, Middlesex and Union, in New Jersey, to a point in Essex county near the northern boundary of Elizabeth and there connecting with the main line of the Pennsylvania R. R. The length of the road is 47 miles. Incorporators, A. J. Cassatt, Wm. A. Patton, Samuel Rea and others of the Pennsylvania R. R. Co., all of Philadelphia, Pa.

Comstock, N. Y.—The Delaware & Hudson Co. (Jas. MacMartin, Ch. Engr., Albany) is reported to have agreed to construct a spur from the main line at Comstock, ¾ of a mile long, and it will necessitate the construction of a bridge across Champlain Canal. The estimated cost will be between $30,000 and $40,000.

Marysville, O.—The Columbus & Lake Michigan R. R. Co. (C. T. Hobart, Gen. Mgr., Lima) is reported to have completed the survey for a new line from Walnut Grove to Marysville. A route will also be surveyed to Columbus.

Cincinnati, O.—Bids will be received by W. M. Duane, of Cincinnati, Supt. of Construction of the Cleveland, Cincinnati, Chicago & St. Louis R.. R. Co., until Jan. 1 (extension of date) for the construction of roadbed on the St. Louis division bet. Indianapolis and Lena, Ind., 4,000,000 cu. yds., and on the Cincinnati division, bet. Middletown and Miamisburg, O., 600,000 cu. yds., as advertised in The Engineering Record.

Toledo, O.—It is reported that a new entrance is to be constructed into Toledo from Hamler for the use of the Detroit, Toledo & Ironton R. R. (O. D. Richards, Ch. Engr., Toledo). It is also reported that about $1,000,000 will be spent by this company for other improvements, including the construction of docks near the Wheeling and Lake Erie bridge.

Ontario, Ore.—J. P. O'Brien, of Portland, Gen. Mgr. Harriman system, is reported to have announced the intention of this road to build, under the name of the Oregon & Eastern R. R., the first 152 miles of a line through Central Oregon, having Ontario, on the eastern boundary of the State, for a terminus, and Natron, a town about 125 miles south of Portland, for a western end.

Manila, P. I.—The following are reported to be the bids opened on Dec. 15 at the Insular Bureau of the War Dept., Washington, D. C., for concessionary grants to be made by the Philippine government for the construction, maintenance and operation of railroads in the Philippine Islands. Speyer & Co., of New York, N. Y., offered to construct about 425 miles of railway in the Island of Luzon without government guarantee of bonds. This offer was made in connection with the existing Manila Ry. Co., Ltd., which now has in operation over 200 miles of railway in Luzon. Morris McMicken, G. Gresskens, G. Poncin, Jacob Furth and E. C. Hughes, of Seattle, Wash., offered to build 100 miles of railway in southern Luzon, designated in the circular as land No. 6, under 4 per cent. guarantee for 30 years on 95 per cent. of the cost of construction. They agreed to complete the road in 3 yrs. Keam, Van Cortland & Co., J. G. White & Co., Charles M. Swift, with whom are associated Cornelius Vanderbilt, R. T. Wilson & Co. and the International Banking Corporation, offered to build 100 miles on the Island of Panay, 100 miles on the Island of Negros and 95 miles on the Island of Cebu under a 4 per cent. guarantee for 30 years on 95 per cent. of the cost of construction. Their bid stated that construction would be done by J. G. White & Co. The proposals submitted are for concessions under which the successful bidders are to build, maintain and operate the several lines of railway. Speyer & Co., in connection with their bid, asked for concessions under which to build branches of the existing Manila & Dagupan Ry., and it is stated that if the bid of Speyer & Co. is accepted it probably will result finally in the operation under one management of 633 miles of railway on the Island of Luzon. The bid of Speyer & Co. was for the line from Manila to Batangas and branches to Santa Cruz and to Lucena; the line from Dagupan to San Fernando and the line from Pasacao to Legaspi, with branches. No bids were submitted for the proposed line from Cabanatuan to Aparri or from San Fernando to Laoag. The bid of the Seattle parties was for the proposed line in southern Luzon, from Pasacao to Legaspi, with branches. This line is included in the bid of Speyer & Co., the former asking for a guarantee and the latter none. There was no competition for the concessions in northern Luzon nor in the islands of Panay, Negros and Cebu, and no bids were submitted for grants in the islands of Leyte or Samar.

Sewickley, Pa.—Robt. Trimble, of Pittsburg, Ch. Engr. M. of W., Pennsylvania Line west of Pittsburg, writes in regard to the abolishment of grade crossing bet. Quaker Valley and Haysville, that the company is negotiating with the borough with this end in view. The company is willing to undertake the work providing it can agree on plans with the borough and some proper distribution of cost of work. No plans have yet been agreed upon.

Galena, S. D.—The Branch Mint Ry. Co., of Galena, is reported incorporated with a capital of $100,000, to construct 5 miles of railway in Lawrence County from Galena to the mines of the Branch Mint Mining & Milling Co. Incorporators: Jas. D. Hardin, Chas. S. Hardin, Thos. McKay and others.

Seattle, Wash.—The Seattle & Eastern Rys. Co. is reported incorporated with a capital of $4,000,000, for the purpose of acquiring and operation of railroads, ferries, steamships, etc., and has authority also to acquire and operate railroads in any State and in any county in the State of Washington. Incorporators: Robt. S. Coe and M. E. Heavey, of Seattle; John McQuaid, of Issaquah, and others.

**Rawlins, Wyo.*—Kilpatrick Bros., of Cambria, Wyo., it is reported, have secured the contract to reconstruct 76½ miles of main line in Wyoming for the Union Pacific R. R.

Ecuador, S. A.—We are informed that the Government of the Republic of Ecuador has decided to build a railroad from Ambato in the province of Tunguraughua, to San Antonio, at the head of navigation on Curaray River, a distance of 120 miles. The object is to develop the rich district east of the Andes Mountains also to shorten the distance of transporting rubber by connecting with the Guayaquil & Quito Ry., at Ambato, thence to the port of Guayaquil on the Pacific side, making a haul by rail of 277 miles, and the entire distance to New York 4,000 miles, instead of 7,000 miles, as at present, via Amazon River. The maximum gradient will be 2 per cent. compensated for a maximum curvature of 7 degrees. The gauge will be 42 in. Eventually electricity will be the motive power. In connection with the electrical development there is available for this purpose the Cascade of the Rio Pastaza as it has a fall of 198 ft. and there are also three other falls conveniently located. The estimated cost of construction and equipment is $6,000,000 in gold, which the Government will appropriate from special funds, $1,000,000 of which will be expended during the coming year. In a few weeks a plant necessary to put 2,000 men at work will be purchased in the United States, and it is expected that actual work will commence in 3 months. The Ecuadorian Government has appointed a commission of seven to look after the work, represented by Luis A. Martinez, Dir. General of Pub. Wks. of Quito, Ecuador. The reconnoissance has been made by Chas. H. Moore, of New York, N. Y., Asst. Engr. Erie R. R. Co., and details of survey by his assistants on the work.

PUBLIC BUILDINGS.

Notes Arranged Alphabetically by States.

Jasper, Ala.—It is reported that plans and specifications will be received by Probate Judge J. W. Shepherd until Jan. 8 for the court house which it is proposed erecting at a cost of about $50,000.

Hot Springs, Ark.—It is stated that bids will soon be asked by Geo. H. Lowers, Bldg. Comr., for the erection of a 3-story brick and terra cotta jail which is to cost about $30,000.

Hampton, Ark.—Gibb & Sanders, of Little Rock, it is stated, have been engaged to prepare plans and superintend the construction of a 2-story brick and terra cotta court house, which is to cost, exclusive of plumbing, heating and equipment, about $35,000.

Denver, Colo.—The Kentucky Home Assoc., it is stated, has been incorporated to build a $100,000 home for consumptives in Denver. Kentucky invalids alone will be cared for. Those interested in the movement are Caldwell Yeaman, Judge Sterling B. Toney, and others.

Washington, D. C.—Bids will be received by Elliott Woods, Supt. U. S. Capitol Bldg. and Grounds, until Jan. 17 for interior cut stone work for the Rotunda section office building, House of Representatives, as advertised in The Engineering Record.

The plans of Marsh & Peter, 520 13th St., have been acepted for erecting the Army General Hospital; cost about $200,000. Bids will probably be received in April.

Tampa, Fla.—It is stated that bids will be received until Jan. 2 by the Bd. Co. Comrs. for erecting an addition to Hillsborough County courthouse. Miller & Kennard, Archts., American Nat. Bank Bldg.

Tallahassee, Fla.—J. N. C. Stockton, it is stated, has been appointed by the Governor's Mansion Comn. as a committee of one to secure plans for the Governor's mansion, which is to be erected on Adams St.

Carnesville, Ga.—The Co. Comrs., it is stated, have engaged W. Chamberlain & Co., of Birmingham, Ala., to prepare plans for the brick and stone court house which is to be erected at a cost of about $45,000.

**Milledgeville, Ga.*—McMillan & Son, of Milledgeville, it is reported, have secured the contract to erect a building for the State Reformatory at Milledgeville, to cost about $10,000.

Macon, Ga.—Bids will be received until Jan. 4 by the Trus. of the Georgia State Academy for the Blind (Ben C. Smith, Chmn.) for erecting a building 310 ft. x 165 ft.; probable cost, $50,000. Alex. Blair, of Macon, is the archt.

Chicago, Ill.—Bids will be received until Dec. 27 by Dept. of Pub. Wks. (Jos. M. Pattison, Comr.) for furnishing material and erecting a 3-story and basement brick and stone police station at 131 Hudson St. Bids are to be submitted separately as follows: masonry and concrete work; iron work; cut stone; roofing; general work; heating; electric wiring.

Indianapolis, Ind.—The Comrs. appointed to have charge of the building of the Southeastern Hospital for the Insane, it is stated, have engaged Foltz & Parker, Union Trust Bldg., to prepare plans for the new building.

Muskogee, Ind. Ter.—The Com. appointed by the City Council to consider the offer of Andrew Carnegie to erect a library here at a cost of $15,000 provided the city donate a site and appropriate $1,500 a year for maintenance, has decided to report in favor of accepting the offer.

**Baltimore, Md.*—The Municipal Bd. of Awards, it is stated, has awarded the contract for the superstructure of the retail market building which is to be erected in Centre Market Space to the Chas. McCaul Co., of Philadelphia, Pa., at $173,470, and the contract for the foundations, concrete by caisson method, to the Cranford Constr. Co., of Washington, D. C., at $16,700. Bids received Dec. 6.

**Fairmont, Minn.*—H. P. Edwards, Co. Aud., writes that the contract for erecting a court house (bids opened Dec. 12) has been awarded to J. B. Nelson & Co., of Mankato, for $86,575.

**St. Paul, Minn.*—The Jas. Forrestal Co., Pioneer Press Bldg., it is stated, has secured the contract for excavating the site for the auditorium (bids for which were received Dec. 9). It is reported that there is about 2,314 cu. yds. of earth and 12,316 cu. yds. of rock to be excavated, and the total cost will probably be $15,000.

Vicksburg, Miss.—It is reported that plans and specifications will be received until Jan. 1 by J. D. Laughlin, Chancery Clk., for a jail.

Kansas City, Mo.—The time for receiving bids by the Bd. of Pub. Wks. for the construction of fire headquarters, it is stated, has been extended from Dec. 20 to Dec. 27.

Milan, Mo.—The citizens are said to be contemplating petitioning the county court for permission to erect a court house at a cost of $50,000.

Gallatin, Mo.—The citizens, it is stated, have voted in favor of erecting a $75,000 court house.

Nashua, N. H.—It is stated that Rev. J. B. H. Milette, pastor of the church of St. Louis de Gonzague of Nashua, has secured a site and intends erecting a hospital on Kinsley St.

Jersey City, N. J.—The following are reported to be the bids received by the Bd. of Freeholders on Dec. 6 for erecting an almshouse: Complete work, Tierney-Connolly Constr. Co., $232,795; Church Constr. Co., $242,000; John H. Parker Co., $264,057. Mason work, Gavin & Davis, $120,000; Chas. Keuderly, $125,000; M. T. Connolly Co., $120,797. Heating, John T. McLaughlin, $39,627; Baldwin Eng. Co., $30,890; Frank Dobson, $41,788; Frank P. Schroeder, $47,000. Plumbing, Wm. J. Murphy, $24,650.

West Point, N. Y.—The following are the bids received Nov. 29 by Maj. J. M. Carson, Jr., Quartermaster, U. S. A., West Point, for the construction of a post headquarters building at West Point: For building complete, J. W. Bishop Co., Worcester, Mass., $442,465; Church Constr. Co., New York, N. Y., $557,000, and John H. Parker Co., New York, N. Y., $499,765. For heating only, John W. Danforth Co., Buffalo, N. Y., $10,600; and C. H. Sanborn, Boston, Mass., $10,492. Electrical work complete, Watson-Flag Eng. Co., New York, N. Y., $4,500, and Chas. F. Brown, New York, $8,494.

Brooklyn, N. Y.—Plans have been filed for a 1-story brick library, 99 x 79 ft., which is to be erected at Lewis Ave. and Macon St., by the City of New York. Walker & Morris, 24 E. 23d St., N. Y., are the archts.

New York, N. Y.—The call for bids for the construction of the Bronx Boro. court house, at Brook Ave. and 161st St., bids for which were to have been opened on Dec. 12 by Louis F. Haffen, Pres. Bronx Boro., was withdrawn before the opening of bids, and the work will probably be again advertised for in January.

Plans were filed Dec. 18 by Robertson & Potter, 160 5th Ave., for a new home for the Colored Orphan Asylum. There will be a group of buildings involving an expenditure of $298,000. The main building will be 3 stories high, 234 x 68 ft., and will be erected on Palisade Ave., east of 261st St. It will cost $200,000. There will also be six 2½-story brick dwelling houses, 48 x 30 ft. each. Total cost, $90,000.

Bids will be received until Dec. 27 by Thos. W. Churchill, Deputy and Acting Fire Comr., for furnishing material required for additions and alterations to the building of Hook and Ladder Co. No. 12.

Isaac Guggenheim, it is stated, has agreed to give $250,000 to the Trus. of the Sydenham Hospital, at 339 E. 116th St., with which it is proposed to erect a new building.

Buffalo, N. Y.—It is reported that plans have been completed for a building to be erected on Elmwood Ave. for the Buffalo Orphan Asylum, at an estimated cost of $40,000.

Greensburg, Pa.—It is stated that bids will be received until Dec. 28 by John D. Hitchman, Co. Compt., for completing the Westmoreland County Courthouse.

Chattanooga, Tenn.—Bids will be received until Dec. 26 by the Bd. Pub. Wks. (A. L. Thomas, Chmn.) for erecting a fire hall in the 9th Ward. R. H. Hunt, Archt., 101 W. 8th St.

Ft. Worth, Tex.—The plans of Alfred Giles, of San Antonio, have been adopted for a 4-story addition to St. Joseph's Hospital; cost, $45,000.

Paris, Tex.—It is stated that bids will be received until Jan. 2 by Barry & Smith, Archts., for erecting the Lamar County Home and Hospital Bldg.

Woodstock, Va.—L. S. Walker, County Clk., writes that bids will probably be received in January for the erection of the Shenandoah County jail; probable cost, $10,000.

Walla Walla, Wash.—The Co. Comrs., it is stated, have selected the plans submitted by Henry Osterman, of Walla Walla for the new county jail, which is to be 2 stories high, 51 x 65 ft., and is to cost $35,000. It is stated that bids for the construction of the building and steel work will be asked very soon.

BUSINESS BUILDINGS.

Notes Arranged Alphabetically by States.

Paragould, Ark.—Witsell Bros., of Nashville, Tenn., it is reported, are arranging to erect a $50,000 wholesale grocery house here.

Siloam Springs, Ark.—It is reported that the officials of the Kansas City Southern Ry. (A. F. Rust, Res. Engr., Kansas City, Mo.) intend erecting a $50,000 hotel here.

San Francisco, Cal.—The Sailors' Union of the Pacific, it is stated, is contemplating the erection of a headquarters and home in this city for sailors, the cost of the building and site to be about $100,000.

Denver, Colo.—F. E. Edbrooke, 510 Opera House Blk., it is stated, is preparing plans for a 6-story hotel which is to be erected at 16th and Glenarm Sts., at a cost of about $300,000.

Colorado Springs, Colo.—The Colorado Midland Ry. Co. (G. W. Vallery, Gen. Mgr., Denver), it is reported, will erect a $50,000 railway station here.

**Hartford, Conn.*—The Travelers' Insurance Co., it is stated, intend erecting a 7-story building at Main and Grove Sts. Marc Eidlitz & Sons, of New York, N. Y., are the builders and Edw. T. Hapgood, 141 Turnbull St., and Donn Barber, of New York, N. Y. (assoc.), are the archts.

Washington, D. C.—It is stated that it is proposed to erect a hotel on N. Capitol and F Sts. at a cost of about $500,000. Jos. A. Burkhart, attorney, may be able to give further information.

Savannah, Ga.—The Y. M. C. A. proposes erecting a new building, to cost about $60,000.

Dublin, Ga.—It is reported that a company is being formed for the purpose of erecting a 5-story hotel on Jackson St., to cost about $100,000. J. D. Smith is reported interested.

Chicago, Ill.—Marshall & Fox are preparing plans for a mercantile building to be built at 241 and 242 Michigan Ave., for Edward T. Blair. It will be 3 stories, 40 x 170 ft., and will cost $40,000.

Fritz Foltz, 140 Dearborn St., has completed plans for a warehouse to be built at Union Ave. and 22d St., for Col. Henry A. Dupont, of Wilmington, Del. It will be 4 stories, of steel and concrete construction and will cost $50,000.

Evanston, Ill.—Geo. W. Maher, it is stated, has prepared plans for a store and office building to be erected in Evanston, for C. A. Wightman, 1563 Sherman Ave., Evanston. It will be 2 stories, 60 x 100 ft., and cost $30,000 to $35,000.

**Muncie, Ind.*—Jos. Schneider, of Muncie, it is stated, has secured the contract to erect a terminal station at Mulberry and Charles Sts., for the Indiana Union Traction Co., at a cost of about $50,000.

Clinton, Ind.—J. C. Bloekedge, it is reported, is head of a company which proposes erecting a hotel here at a cost of $35,000.

* *Items marked thus give the names of parties awarded contracts.*

Muskogee, Ind. Ter.—The erection of a Y. M. C. A. building here, to cost about $25,000, is reported under consideration. J. F. Denham, of Oklahoma City, Okla., Territorial Secy., may be able to give further information.

Des Moines, Ia.—The Rothwell Blk. on Walnut St., it is stated, has been destroyed by fire.

Iola, Kan.—F. V. Couch, it is reported, is interested in the erection of a $60,000 hotel here.

New Orleans, La.—The Gulf Bag Co., it is stated, is about to erect a 4-story fireproof warehouse on Tchoupitoulas, Commerce, Notre Dame and Julia Sts.

*_Opelousas, La._—The Bd. of Directors of the Opelousas Improv. & Development Co., it is stated, has awarded the contract to erect a brick hotel at Court and Bellevue Sts. to Ventre & Pulford, of Opelousas, at an approximate cost of $50,000.

Baltimore, Md.—Lawrence Turnbull, it is stated, is having plans prepared for a 6-story store building, which he proposes erecting at 311 W. Baltimore St.

Baltimore, Md.—See "Miscellaneous."

Worcester, Mass.—The Bldg. Com. of the Eagle Lodge, I. O. G. T. (Fritz Anderson, Chmn.) is contemplating the erection of a building on Belmont St., to cost about $12,000. Nels Patterson is reported to be the archt.

*_Boston, Mass._—The Webb Pink Granite Co., of Worcester, it is stated, has secured the contract to furnish all the pink granite needed in the construction of the John Hancock Co.'s Bldg. on Federal, Franklin and Devonshire Sts., Boston. It is stated that the contract will amount to about $150,000.

Flint, Mich.—The members of the Flint Lodge F. & A. M., it is stated, are contemplating the erection of a temple to cost $50,000.

Minneapolis, Minn.—It is stated that plans have been completed for a 5-story warehouse, 66 x 145 ft., which is to be erected at 9th Ave. and 4th St. for the Kellogg, Mackay, Cameron Co., at a cost of about $70,000.

The members of the Minneapolis Club, it is reported, have engaged Ernest Kennedy, 442 Boston Blk., to prepare plans for the club house which they propose erecting at 8th St. and 2d Ave., at a cost of about $200,000

*_Kansas City, Mo._—The Urban Constr. Co., Bank of Commerce Bldg., it is stated, has secured the contract to erect a 6-story brick and reinforced concrete fireproof building at Central and 22d Sts. for the D. A. Morr Storage Co., the cost to be about $150,000.

*It is stated that the Missouri, Kansas & Texas R. R. Co. has awarded the contract to erect a freight house at Wyoming and 15th Sts. to Turner Bros. of Rosedale, at about $100,000.

St. Louis, Mo.—The Ely-Walker Dry Goods Co. contemplates erecting a 9-story building here, at a cost of $850,000. No architect selected as yet.

The Missouri State League of Republican Clubs, it is stated, has decided to erect a $50,000 club house. Frank J. Orff, Pres.

Omaha, Neb.—The Cosmopolitan Hotel Co., it is stated, has been incorporated with a capital of $255,000. It is stated to be the purpose of the company to erect an 8-story hotel at a cost of about $400,000. The Bd. of Directors includes Arthur C. Smith, C. H. Pickens and others.

*Parsons & Kiene, it is reported, have secured the contract to erect the Y. M. C. A. bldg., at about $200,000.

The Carpenter Paper Co., it is reported, has directed John Latenser, Bee Bldg., to prepare plans for a 6-story warehouse, to be erected at 9th and Howard Sts. Estimated cost, $100,000.

Schenectady, N. Y.—It is stated that Mrs. Agnes Barry, of Albany, is contemplating the erection of a theatre on State St., to cost about $50,000.

Brooklyn, N. Y.—Plans have been filed for a 5-story brick store and tement., which is to be erected at Pitkin and Stone Aves., at a cost of $35,000. Owner, S. Lavine, 1691 Eastern Parkway; archt., R. Rassmussen, 30 Graham Ave.

Buffalo, N. Y.—The officers of the Buffalo City Cemetery, it is stated, have decided to erect a new gate and office at the Delaware Ave. entrance to Forest Lawn, the cost to be about $50,000. Wm. H. Glenny is Chmn. Com. having the matter in charge.

New York, N. Y.—The members of the Amateur Comedy Club (Howard S. Borden, Pres.), it is stated, are contemplating the erection of a 10-story building in 48th St., between B'way and 6th Ave., at a cost of about $300,000. Plans for the proposed building, it is reported, have been prepared by Howard M. Peck, a member of the club, and provide for a theatre on the first floor and club rooms and offices on the other floors.

The new wood, copper and steel union ferry terminal, including the sheds and boat slips of the Delaware, Lackawanna & Western R. R., and the Central R. R. of New Jersey, at the foot of W. 22nd and 23rd Sts., was destroyed by fire Dec. 20. The loss to the heating and lighting plant underneath the D., L. & W. building, it is said, will be heavy. This plant was intended for the use of the Delaware, Lackawanna & Western, the Central Railroad of New Jersey and the new house of the Erie R. R.. It contained 8 high-pressure boilers of a new type, and was equipped with elaborate devices for its work.

Columbus, O.—It is stated that the erection of a theatre and business building on Broad St., to cost about $300,000, is under consideration. Chas. Lane, Pres. Central Lumber Co., may be able to give further information.

Toledo, O.—Harry W. Wachter, Archt., 701 The Nasby, writes that bids will probably be received about the 1st of Jan., for the erection of a 3-story Arcade on Erie St. The cost of this building is reported to be about $100,000.

It is stated that a 2-story store and flat building is to be erected at Collinwood and Delaware Aves. for W. R. Croft at a cost of $35,000.

Cleveland, O.—The W. M. Pattison Supply Co., it is stated, intends erecting a 2-story brick warehouse, 46 x 247 ft., on Case Ave. and Hamilton St., at a cost of $25,000. Watterson & Clague, 197 Forest St., it is stated, have the contract for the mason work on the building.

The Cleveland Telephone Co., it is stated, has had plans prepared by Hubbell & Benes, Citizens' Bldg., for a 3-story brick and terra cotta exchange bldg., which is to be erected on Prospect St., at a cost of $60,000.

Lorain, O.—The Verbeck Theatre, it is stated, has been destroyed by fire. It is reported that it will be rebuilt by the Verbeck syndicate.

Cincinnati (East End), O.—It is reported that the Pennsylvania R. R. Co. (W. H. Brown, Ch. Engr., Philaadelphia, Pa.) proposes to build a $25,000 depot at Waterloo and Columbia Aves.

Sidney, O.—The Manufacturers' Assoc., it is reported, is arranging to erect a $40,000 opera house.

Oklahoma City, Okla.—It is reported that plans have been drawn for a union station which is to be erected in this city, and that an appropriation of $200,000 has been made for the purpose. W. L. Darling, Ch. Engr., Chicago, Rock Island & Pacific R. R., Chicago, Ill., may be able to give further information.

S. S. Baldwin, of Wichita, Kan., Pres. Bijou Theatre syndicate, it is reported, is contemplating the erection of a theatre on W. Main St., to cost $40,000.

*_Washington, Pa._—The Pennsylvania R. R. Co., it is stated, has awarded to the N. Vankirk Co., of Washington, the contract to erect a union station here to cost about $40,000.

*_Chester, Pa._—The contract to erect the Y. M. C. A. bldg., at 7th St. and Edgmont Ave., it is stated, has been secured by Wm. Provost, Jr., of Chester, at $87,500. The contract for the ventilating and heating of said building, it is stated, has been awarded to Saml. C. Turner, 5th St. and Edgmont Ave., at $7,900.

Harrisburg, Pa.—Christian Hershey, prop. of the Hershey Cafe on Market St., is reported to be contemplating the erection of a 6-story hotel to cost $50,000.

Charleston, S. C.—John F. Maybank, it is stated, will erect a cotton warehouse in this city, to cost about $50,000.

Bennettsville, S. C.—The Masons, it is stated, are contemplating the erection of a temple at a cost of $15,000.

Nashvile, Tenn.—The Mecklenburg Real Estate Co., it is reported, has organized with a capital of $1,000,000, and will erect a building for the Fourth National Bank at Third Ave. and Union St.

Memphis, Tenn.—Chiglizola, Hanker & Cairns, Scimitar Bldg., it is stated, have prepared plans for a 3-story brick addition to be erected to the Giannotti Hotel, at a cost of about $20,000.

Salt Lake City, Utah.—D. S Holmes, proprietor of the Knutsford Hotel, it is stated, proposes to erect a 4-story business building. Estimated cost, $75,000.

Lynchburg, Va.—The erection of a Y. M. C. A. bldg. at a cost of about $90,000 is reported under consideration.

Seattle, Wash.—H. Ryan, Globe Bldg., it is stated, has prepared plans for a 7-story hotel which is to be erected at 7th Ave. and Pike St., at a cost of about $200,000. J. F. Douglas, Pres. of the Manhattan Bldg. Co., is reported interested.

Chippewa Falls, Wis.—The officials of the Chicago, St. Paul, Minneapolis & Omaha Ry. (C. W. Johnson, Ch. Engr., St. Paul, Minn.), it is reported, propose erecting a station here estimated to cost $15,000.

Madison, Wis.—F. W. Kehl, it is reported, intends erecting a theatre here on W. Dayton St., to cost about $50,000.

New York, N. Y.

18 and 20 W. 21st St., 11-story br. store and loft bldg., c, $100,000; o, Josephine D. Robinson; a, C. Dunne.

65th St. and 2d Ave., 6-story br. and stone store and tenemt.; c, $35,000; o, Joseph Isaacs; a, M. Zipkes.

86th St. and Ave. A, 3 br. and stone stores and tenemts.; total c, $120,000; o, Grossman & Sundelevich; a, Horenburger & Straub.

92d St. and 1st Ave., 6-story br. and stone store and tenemt.; c, $55,000; o, Forman & Aronson; a, Geo. F. Pelham.

104th St. and Park Ave., two 6-story br. and stone stores and tenemts.; total c, $65,000; o, Levinson & Zipkin; a, M. Zipkes.

Ave. A and 75th St., 6-story br. and stone store and tenemts.; c, $20,000; o, Sydney Wallenstein; a, Horenburger & Straub.

Bradhurst Ave. and 145th St., 5-story br. and stone store and tenemt.; c, $60,000; o, Harry Matz; a, Harry T. Howell.

Westchester and Robbin Aves., two 5-story brick store and tenemts.; total c, $100,000; o, Mercury Realty Co.; a, Goldner & Goldberg.

CHURCHES AND DWELLINGS.

Notes Arranged Alphabetically by States.

Little Rock, Ark.—Gibbs & Sanders, of Little Rock, it is reported, have prepared plans for an apartment house to be erected by the Citizens' Investment & Security Co.

Des Moines, Ia.—John Cownie, it is stated, is contemplating the erection of a residence at a cost of $15,000.

Winfield, Kan.—The members of the First Methodist Church, it is stated, have subscribed $20,000 for the erection of a new edifice.

Louisville, Ky.—Clayton S. Longes, it is stated, intends erecting a flat on 3rd Ave. and Bway., to cost about $50,000.

Mittineague, Mass.—It is reported that the members of the St. Thomas Episcopal Church intend rebuilding the edifice at a cost of $25,000. Rev. Jas. J. Tyrol, Pastor.

Syracuse, N. Y.—The members of the Holy Trinity R. C. Church, it is reported, are preparing to erect a new edifice at a cost of $50,000. Rev. John Reuland, Pastor.

Zanesville, O.—Chas. D. Wedge, vice-pres. and gen. mgr. of the Griffith & Wedge Co., it is stated, proposes erecting a residence to cost $12,000.

Columbus, O.—It is stated that plans are being prepared for an edifice which is to be erected for the Central Christian Church of Christ at a cost of $30,000.

Allegheny, Pa.—Vrydaugh & Wolfe, of Pittsburg, it is reported, have completed plans for a $20,000 edifice to be erected for the congregation of the Morning Side Presbyterian Church.

Seattle, Wash.—Saunders & Lawton, New York Blk., it is stated, have prepared plans for a 6-story apartment house to be erected by Bert Farrar and E. W. Herald, at Terry Ave. and Marion St.

Appleton, Wis.—Leenhouts & Guthrie, of Milwaukee, it is stated, are preparing plans for a church to be erected at Appleton for the St. Paul Evangelical Lutheran congregation. The building will be of solid brick, 57x 120, and cost $22,000.

Winnipeg, Man.—It is stated that the St. Boniface Cathedral is to be erected in the spring, at a cost of $250,000.

Halifax, N. S.—St. Luke's Cathedral, it is reported, was destroyed by fire on Dec. 14.

New York, N. Y.

315 E. 84th St., 6-story br. and stone tenemt.; c, $60,000; o, Kramer & Rockmore; a, Geo. F. Pelham.

Lexington Ave. and 123d St., two 6-story brick and stone tenemts.; total c, $90,000; o, A. M. Bachrach; a, Lorenz F. J. Weiher.

95th St. and Amsterdam Ave., 6-story brick and stone tenemt.; c, $100,000; o and a, A. B. Knight.

122d St. and Amsterdam Ave., two 6-story brick and stone tenemts.; total c, $150,000; o, Krulevitch Realty Co.; a, Bernstein & Bernstein.

110th St. and Bway., 9-story br. and stone apartment house; c, $200,000; o, 110th St. Co.; a, Snelling & Potter.

158th St. and Amsterdam Ave., 5-story brick and stone tenemt.; c, $50,000; o, Jennie Lyman; a, Moore & Landsiedel.

524 W. 158th St., two 6-story brick and stone tenemts.; total c, $100,000; o, A. Horowitz & Son; a, Saml. Sass.

178th St. and St. Nicholas Ave., two 5-story brick and stone tenemts.; total c, $100,000; o, Harry Adelson; a, B. W. Levitan.

St. Nicholas Ave. and 177th St., five 5-story brick and stone tenemts.; total c, $185,000; o, Hermann Strauss; a, Schwartz & Gross and B. N. Marcus.

Wadsworth Ave. and 177th St., three 5-story brick and stone tenemts.; total c, $125,000; o, H. M. Ellander; a, B. M. Levitan.

Dawson St. and Longwood Ave., six 5-story brick tenemts.; total c, $180,000; o, John McGovern; a, J. C. Cocker.

146 St. and Brook Ave., two 6-story brick tenemts.; total c, $110,000; o, Jos. Simerman & Co.; a, Geo. F. Pelham.

Grant Ave. and 162d St., 6-story brick tenemt.; c, $60,000; o, Waverley Constr. Co.; a, Harry T. Howell.

Montgomery, Andrews and Fremont Aves. and 176th St., brick home, Messiah Home for Children; c, $300,000; o, H. H. Rogers; a, Chas. Brigham.

Prospect Ave. and 151st St., two 5-story brick tenemts.; c, $90,000; a, The Four Realty Co.; a, John Hauser.

SCHOOLS.

Notes Arranged Alphabetically by States.

Little Rock, Ark.—The Bd. of Pentitentiary Comrs., it is stated, has secured a site and intend erecting a reform school. Appropriation, $30,000.

San Jose, Cal.—See "Sewerage and Sewage Disposal."

South Pasadena, Cal.—The erection of a $70,000 school is reported under consideration.

*_Greenwich, Conn._—Ambrose B. Stannard, St. James Bldg., New York, N. Y., is stated to have secured the contract for a high school to be erected here for about $100,000.

Washington, D. C.—It is reported that the main building at the Boys' Reform School of the Dist. of Columbia was destroyed by fire on Dec. 19.

*_Gainesville, Fla._—The State Bd. of Control of the Univ. of Florida has awarded to the W. T. Hadlow Co., of Jacksonville, the contract to erect 2 dormitory buildings at the Univ. at Gainesville (bids for which were received Dec. 11) for $75,250. Edwards & Walter, Archts., Columbia, S. C.

It is reported that bids will be received by the State Bd. of Control until Jan. 8 at Jacksonville for erecting cottages, barns, etc., at the Univ.

Augusta, Ga.—It is reported that Jan. 15 the Bldg. Com. of the Bd. of Educ. will consider plans for the 5th Ward School.

Chicago, Ill.—The Com. on Schools of the Bd. of Educ., it is stated, has authorized the erection of a 24-room school at Perry and Granville Sts., at a cost of $175,000 and the erection of a 6-story addition to Brentano School, at a cost of $45,000.

J. E. O. Pridmore, Champlain Bldg., it is stated, has been engaged to prepare plans for two buildings, one to contain an assembly hall and the other an auditorium, to be built on the east side of Sheffield Ave., north of Webster Ave., for St. Vincent's College. The buildings will be 2-story, pressed brick and will cost $25,000 and $50,000 respectively. It is reported that it may be 6 months before bids will be received for the construction.

St. Charles, Ill.—The Bd. of Directors of the St. Charles State School for Boys, it is reported, intends making improvements to cost about $30,000.

*_Lafayette, Ind._—It is reported that Strate & Jones have secured the contract to erect a high school here at $45,354.

*_Cedar Falls, Ia._—It is stated that contracts have been awarded as follows for erecting a $60,000 physical science building at the Iowa State Normal School: Cut stone, Arthur Watson, of Cedar Falls; brick, Gethman Brick Co., of Gladbrook; heating, Sturtevant Co., of Boston; thermostats, Johnson Co., of Chicago, Ill.

Baltimore, Md.—Tormey & Leach, it is stated, are preparing plans for a 3-story brick or stone addition which is to be erected at the St. Mary's Industrial School for Boys at Wilkens and Canton Aves.

Quincy, Mass.—Aaron H. Gould, Archt., 17 Milk St., Boston, writes that bids will be received on Dec. 28 by the Bd. of Pub. Wks. for the erection of an addition to the high school, to cost $100,000.

Marquette, Mich.—The south wing at the Northern Normal School, it is reported, has been destroyed by fire.

Kalamazoo, Mich.—The Bd. of Educ., it is stated, has decided to erect a school next spring in the southern part of the city, the cost to be about $60,000.

* Items marked thus give the names of parties awarded contracts.

Clinton, Miss.—It is stated that a fund of $120,000 is being raised by Pres. Dr. Lowrey, of Mississippi College, with which he proposes erecting and equipping buildings at the college.

Columbus, Miss.—The question of issuing $50,000 bonds for the purpose of erecting a school is reported under consideration.

St. Louis, Mo.—The following are reported to be the lowest bids received Dec. 11 by the Bldg. Com. of the Bd. of Educ. for erecting a building to replace the present Lafayette School: General work, Fred Boeke, $136,500; plumbing and sewering, Crane-Clancy Plumbing Co., $9,275; heating and ventilating, B. F. Sturtevant & Co., $15,947; electric work, Eclipse Elec. Co., $5,350. Total, $167,072.

**Webster Groves, Mo.*—J. W. Wilson & Son, of St. Louis, Mo., it is stated, have secured the contract to erect the central high school at about $24,350.

Grand Island, Neb.—It is reported that bids will be received by the Secy. of the School Bd., until about Jan. 15, for $60,000 school bonds, the proceeds to be used to erect a high school.

Omaha, Neb.—A building permit has been issued for a 2-story brick dormitory, to be erected at Creighton Univ., at a cost of $25,000.

Paterson, N. J.—The plans submitted by Wm. T. Fanning, 138 Jersey St., it is stated, have been accepted for the high school which is to be erected on Hamilton St., at a cost of about $250,000.

**Gloversville, N. Y.*—The following are reported to be the bids received Dec. 13 for erecting a high school: General construction, Dewitt A. Hayes, Gloversville, $71,500 (awarded contract); Peter Keeler Bldg. Co., Albany, $76,800 Jas. E. Leemey, Syracuse, $81,000 A. L. Henry, Gloversville, $83,665. Plumbing and heating: Breen Bros., Utica, $6,300 (awarded contract), and Cornelius Dwyer, Amsterdam, $6,773. Electrical work: A. C. Scribner, Gloversville, $2,480 (awarded contract); Stewart & Jansen, Gloversville, $2,629, and Edward Joy, Syracuse, $3,746.

New York, N. Y.—Bids will be received until Jan. 2 by C. B. J. Snyder, Supt. School Bldgs., for installing, ventilating and heating apparatus in new school No. 42, Boro. Bronx; also school No. 92, Boro. Brooklyn.

All bids opened Dec. 18 by C. B. J. Snyder, Supt. School Bldgs., for installing ventilating and heating apparatus for alterations in and additions to public school 10, Manhattan Boro., have been rejected. The following are the bids received: Frank Dobson, $29,792; Leonard D. Hosford, $31,742, and E. Rutzler Co., $29,498.

*The following are the bids opened same time and place for installing ventilating and heating apparatus in school 3, Boro. of Manhattan: Evans, Almirall & Co., 281 Water St., $31,859 (awarded contract); Dowdeswell Bros., $33,098; Rossman & Bracken Co., $32,000; Geo. A. Suter, $35,892; E. Rutzler Co., $32,767; Wm. J. Olvany, $35,990; Leonard D. Hosford, $34,430, and Blake & Williams, $34,341.

Jamestown, N. Y.—Plans have been completed, according to reports, for a grammar school which it is proposed erecting at a cost of $105,000.

**Flushing, L. I., N. Y.*—The following are the bids opened on Dec. 18 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for general construction, etc., of School 25, Queens Boro.: Jas. MacArthur, $25,781; Chas. Wille, 39 E. 42d St., N. Y. City, $25,643 (awarded contract); Jos. Ohlhausen, $26,944; Edw. Stapleton, $28,500.

Far Rockaway, L. I., N. Y.—It is stated that a 12-room addition is to be erected at the high school.

Grand Forks, N. D.—J. W. Ross, Rm. 20-22 Security Blk., it is stated, has prepared plans for an addition which it is proposed erecting next spring to the St. Bernard Academy at a cost of about $25,000.

Lima, O.—The Board of Educ., it is stated, has decided on the cottage plan for the building to be erected on West lot. The structure will be either 16 or 24 rooms, of brick and will be built on the installment plan in a series of 8 rooms each year. The first 8 rooms will cost $23,000.

Akron, O.—Milton E. Harpster, it is stated, has been engaged as architect of the new high school. The structure will cost $100,000, and the plans will be prepared immediately.

Sherman, Tex.—Dr. T. S. Clyde, of Sherman, Pres. of Austin College, writes that it is proposed to erect a dormitory at a cost of $25,000. Bulger & Son, Archts., Dallas.

Elm Grove, W. Va.—Architect Chas. D. McCarty, of Wheeling, writes that bids will be received about Feb. 1 for the erection of a school at Elm Grove, to cost about $42,000.

Madison Wis.—The Bd. of Regents, it is stated, has authorized Archt. Peabody to prepare plans for an agronomy building at the College of Agriculture, at a cost of $18,000.

Chippewa Falls, Wis.—The issuing of $60,000 bonds for the erection of a high school is reported under consideration.

Barron, Wis.—The citizens, it is stated, have voted in favor of erecting a school at a cost of $25,000.

Neenah, Wis.—It is stated that plans and specifications will be received by Supt. of Schools Beeman until about Jan. 8 for the Kimberly high school.

STREET CLEANING AND GARBAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Ocean Park, Cal.—The City Clk. writes in regard to the construction of a garbage disposal plant that bonds have not yet been sold. Bids for construction have not been called for as yet.

Detroit, Mich.—The following are reported to be the bids opened on Dec. 11 by F. A. Blades, City Comr., for garbage plant or plants having an aggregate capacity of 200 tons per day

Dixon Garbage Crematory Co., Toledo, O., four 50-ton plants, $80,000.

Detroit Sanitary Works, to sell its plant at French Landing, Mich., increased to 200-ton capacity, including 13 acres of land and seven 2-story workmen's houses, for $100,000.

Lewis & Kitchen, Chicago, Ill., submitted 7 bids from *a* to *g*, as follows: *a* storage capacity 50 tons, 1 plant, $26,540; 2 plants, $51,600; cost of cremation, 45 cts. per ton; *b* 60 tons, 1 plant, $31,860; 2 plants, $59,800 and 40 cts. per ton; *c* 100 tons, 1 plant, $35,650; 2 plants, $68,400 and 30 cts. per ton; *d* 120 tons, 1 plant, $41,080; 2 plants, $77,800 and 30 cts. per ton; *e* 100 tons, $52,590, 45 cts. per ton; *f* 120 tons, $61,680 and 35 cts. per ton; *g* 200 tons, $69,875 and 25 cts. per ton. Several other bids were received, but, it is reported, were not read on account of being irregular.

For the disposal of garbage the Detroit Sanitary Works, of Detroit, bid for 1 yr. $24,600; 3 yrs., $14,600 per yr.; 5 yrs., $13,600 per yr., and 10 yrs., $12,000 per yr. The Detroit Reduction Co., of Detroit, 10-yr. contract, no compensation. If this proposal is accepted the company agrees if desired to dispose of all household and shop waste, office and street sweepings and ashes, and all other rubbish, at 25 cts. per ton; and if ashes is kept separate from above, for 20 cts. per ton. Disposal of night soil, 25 cts. per bbl. The company agrees to sell its plant to the city at an appraised valuation at any time prior to the termination of the contract.

**Brooklyn, N. Y.*—Wm. Bradley, 86th St. & Bway., N. Y. City, it is stated, has secured the contract for the removal of snow and ice from the streets of the Boro. of Brooklyn during the year 1905 and 1906 (bids for which were opened Dec. 6) at 21½ cts. per cu. yd.

Erie, Pa.—See "Sewerage and Sewage Disposal."

**York, Pa.*—Chas. C. Fischer, of Reading, is reported to have secured the contract for disposing of the organic and inorganic garbage of the city for a period of 10 yrs. at an average of $16,260 per year. The contract will go into effect on Apr. 1, 1906, and Mr. Fischer expects to have his plant erected and in operation at that time.

NEW INDUSTRIAL PLANTS.

See also Business Buildings.

Miles Steel & Tool Co., Middletown, O., will erect a new plant. A small amount of machinery will be purchased.

The Clinton (Ill.) Ice & Cold Storage Co. will in the spring install a 20-ton ice plant. This company is at present building a storage house 68 x 28 ft.

Rhodes Mfg. Co., Lincolnton, N. C., mfrs. of cotton yarns, has purchased site for a new mill. Plans have not yet been completed for the new mill or its equipment.

Mr. Maurice C. Trumbull, Red Bird, Ark., will erect at that point several large buildings to be used as saw mill, dry kilns and planing mill. New machinery will be required.

The Florida Refining Co., Jacksonville, Fla., will erect a new plant consisting of two main buildings, storage shed and boiler house, according to local newspaper reports.

J. Landis Shoe Co., Palmyra, Pa., whose plant was recently burned, is in the market for an engine direct connected to dynamo of 300 16-cp. light capacity; also a 50-h.-p. engine.

The Climax Specialty Co., Seneca Falls, N. Y., mfrs. of plumbers' specialties, is building an addition to its plant, and is in the market for monitor turret machines and smaller supplies.

The Standard Pulley Co., Cincinnati, O., has prepared plans for a new foundry, 170 x 110 ft., and a new machine shop, 170 x 65 ft. This company is in the market for a 75 to 100 h.-p. plant.

Geo. E. Dow Pumping Engine Co., San Francisco, Cal., has purchased site at Alameda, Cal., for the location of a new plant. Plans for this plant will be prepared in the near future.

McCleary, Wallin & Crouse, Amsterdam, N. Y., are building a five-story brick building to be used for the manufacture of tapestry carpets. The question of power equipment has not been definitely decided.

Acme Cement Stone Co., Chattanooga, Tenn., is building a new plant and is in the market for gas and gasoline engines, air compressor and machinery for the manufacture of special designs of cement blocks.

Rand, McNally & Co., Chicago, Ill., printers and publishers, have purchased site for a new plant at Ossining, N. Y., erection to be commenced in the spring. This company will shortly place orders for new printing presses.

The Standard Spinning Co., Oswego, N. Y., is erecting a new two-story building measuring 53 x 36 ft., to be used as case shop and waste house. This company is in the market for an elevator and a power press for baling waste.

The Lafayette (La.) Syrup Factory has prepared plans for a new plant, the main building of which will measure 100 x 60 ft., 6 stories high. This company is in the market for one 80-h.-p. boiler, 4 steel tanks, 2 classifiers, 4 evaporators, 1 filter box and 4 pumps.

The Citizens' Mfg. Co., De Land, Fla., recently organized with $50,000 capital, will manufacture gas and ice, and is in the market for a water-oil gas outfit having 50,000 cu. ft. per day capacity, and a 6-ton ice-making plant. Mr. J. H. Kruse is superintendent of the company.

The Shenango Iron & Steel Co., Wheatland, Pa., has purchased the plant of the Independent Rolling Mill Co., at Cuyahoga Falls, O., which will be moved to Wheatland. Little new machinery will be installed at present, though later on the company will add an 18-in. finishing bar mill to its equipment.

Keuffel & Esser Co., Hoboken, N. J., whose plant was recently destroyed by fire, will probably begin rebuilding in the near future. Plans have not yet been completed, but the new plant will likely consist of main building measuring 50 x 200 ft., 5 stories high and boiler plant having a capacity of 500-h.-p.

Dominion Iron & Steel Co., Sydney, Cape Breton, Canada, will shortly install two Bessemer converters which will be used to desiliconize pig iron before it is taken to the open hearth. The exact size of the converters to be installed has not been determined, though they will probably be of 15 or 20 ton capacity each.

Morley Twine & Machinery Co., Sioux City, Ia., is erecting a new plant consisting of main building, 90 x 320 ft.; two warehouses, 60 x 100 ft. each; power house, 50 x 60 ft. and office building, 60 x 50 ft. This company is ready to receive bids on complete equipment for 600-h.-p. power plant, together with sprinkler system for fire protection.

The Cyclone Drilling Machine Co., Orrville, O., has increased its capital stock for the purpose of enlarging its plant, which will be done soon after January 1st. While the plans have not yet been definitely arranged, this company will be in the market for iron working machinery, boring mills, etc., together with a 50-h.-p. engine.

Mallison Braided Cord Co., Athens, Ga., will erect a new mill building, to measure 75 x 200 ft. A 500-h.-p. water power will be developed for the operation of the new plant. For this purpose the company will purchase horizontal water wheels and a 400-kw., 3-phase A. C. generator, operating at 60 cycles, 2,300 volts. This company is also in the market for a full equipment for the manufacture of 8 to 16, 3 and 4 ply yarns on tubes and skeins.

MISCELLANEOUS.

Notes Arranged Alphabetically by States.

San Jose, Cal.—See "Sewerage and Sewage Disposal."

Washington, D. C.—See "Power Plants, Gas and Electricity."

Chicago, Ill.—Local press reports state that the new Drainage Board (Robt. R. McCormick, Pres.) will probably petition Congress to undertake the work of completing the widening and deepening of Chicago River, in order to provide the proper dilution of the water it is estimated that this work will cost about $3,000,000.

South Bend, Ind.—About $10,000 will be expended during the coming year in the recently acquired Leeper and Coquillard Parks. Macadamized drives and walks will be laid out and a greenhouse erected. Herman H. Beyer, Park Supt.

Iowa City, Ia.—It is stated that bids are wanted until Jan. 3 for excavating a drainage ditch in Sections 25, 35 and 36. L. J. Baschnagel, Co. Aud.

Council Bluffs, Ia.—S. E. Etnyre, City Engr., writes that no bids were received on Dec. 4 for the excavation of Indian Creek, from 16th Ave. to 8th St., said work to consist of about 100,000 cu. yds. of excavation. New bids will probably be called for in February. L. Zirmuehlen, Jr., City Clk.

New Orleans, La.—Bids will be received until Jan. 6 by Capt. J. F. McIndoe, Corps Engrs., U. S. A., for constructing about 395,200 cu. yds. of levee work in the Atchafalaya Levee Dist., and 107,500 cu. yds. of levee work in the Lake Borgne Levee Dist.

Baltimore, Md.—Simonson & Pietsch, Hoen Bldg., are reported to be preparing plans for improvements to be made to Riverview Park, including the erection of new buildings, a new pier, large bath houses, etc. The new improvements will cost about $100,000, and will be made jointly by the United Rys. and Electric Co., the G. B. S. Brewing Co., and Michael J. Fitzsimmons.

**Boston, Mass.*—Wm. L. Miller, 19 Milk St., is reported to have secured the contract for repairing wharf and building at Rainsford Island, Boston Harbor (bids opened Dec. 14) for $6,563.

**Alexandria, Minn.*—E. P. Wright, County Aud., writes that Jerry Sherwood, of Litchfield, Minn., has secured the contract for constructing the main ditch at $5,577, and John Gaugl, of Freeport, Minn., for constructing branches at $2,817 (bids opened Dec. 12).

Kansas City, Mo.—R. C. Barnett, Engr., for the Citizens Com., in charge of the proposed 15th St. tunnel and viaduct project, writes that this committee now has under consideration the ordinance by which the City Council grants it a franchise to construct this tunnel and system of viaducts. The cost of construction is estimated at about $4,000,000. Bids will not be called for until preliminary work of organizing is completed and money procured for doing the work. All communications to committee should be addressed in care of W. R. Jacques, 509 Bank of Commerce Bldg.

Bozeman, Mont.—The Spanish-Ferris Ditch Co. is reported incorporated, with a capital of $42,000, its principal place of business to be in Bozeman.

Elizabeth, N. J.—The Bd. of Aldermen on Dec. 15 authorized the Mayor and City Attorney to purchase a site on the Staten Island Sound at Livingston St., Elizabethport, on which to construct a recreation pier.

Albany, N. Y.—The Advisory Bd. of Consulting Engineers of the State barge canal improvement is reported to have on Dec. 19 approved of the plans for the construction of locks 4, 5 and 6, covering a territory of 1¾ miles north of Cohoes. The plans will involve the expenditure of about $2,000,000. The plan was also approved by the canal board on Dec. 19 and the State Supt. of Pub. Wks. will soon call for bids for the work.

**New York, N. Y.*—The Brown & Fleming Contracting Co., 129 Broad St., has secured the contract for furnishing and putting in place 20,000 cu. yds. rip-rap stone, class 2, at 39 cts. per cu. yd.; total cost, $7,800 (bids opened Dec. 15 by the Dept. of Docks and Ferries).

Brooklyn, N. Y.—Bids will be received until Dec. 30 by Nicholas J. Hayes, Fire Comr., New York City, for furnishing material and installing fire alarm telegraph cable for the fire alarm telegraph system.

Wilmington, N. C.—Bids will be received by Capt. R. P. Johnston, Corps Engrs., U. S. A., until Jan. 15, for a 4-pocket bottom dump scow, as advertised in The Engineering Record.

Items marked thus give the names of parties awarded contracts.

**Wheeling, W. Va.*—The following are the bids opened on Dec. 12 by Maj. Geo. A. Zinn, Corps Engrs., U. S. A., for building Dam No. 13, Ohio River: (*a*) Dravo Contr. Co., Pittsburg, Pa.; (*b*) Jas. H. McQuade Co., Pittsburg, Pa.; (*e*) Ohio River Contract. Co., Evansville, Ind.; (*d*) Hollerbach & May Contract Co., Evansville, Ind. (awarded contract, according to reports.).

	a	*b*	*c*	**d*
62,551 cu. yds. excav	$1.00	$0.95	$0.60	$0.65
14,276 cu. yds. fill	.60	.85	.75	.80
6,706 cu. yds. stone fill	3.50	4.75	3.75	3.00
5,440 cu. yds. riprap	3.80	4.75	3.75	3.00
15,065 cu. yds. concrete	8.50	8.00	8.00	8.10
183 M. ft oak timber	90.00	90.00	80.00	80.00
347 M. ft. hemlock timber	65.00	70.00	60.00	60.00
176 M. ft. decking	65.00	90.00	50.00	60.00
22,900 lin. ft. sheet piles	.80	.82	.75	.75
45,760 lin. ft. piles	.60	.65	.65	.50
658 cu. yds. paving	7.00	6.50	8.00	6.00
324 lin. ft. curb	1.00	4.50	1.50	1.00
1,800 lin. ft. drill holes, 2-in	.50	1.00	.75	.50
5,067 lin. ft. pipe and fittings	1.50	1.00	1.00	1.00
27,700 lbs. reinforcing bars	.06	.05	.05	.05
118,600 lbs. structural steel	.07	.08	.06	.05
364,900 lbs. castings	.06	.06	.06	.05
527,900 lbs. forgings	.07½	.12	.06	.05
152,000 lbs. bolts and miscell. iron	.06½	.06	.06	.05
Total	$434,314	$472,730	$388,840	$363,557

Cleveland, O.—Bids will be received at the office of Wm. H. Evers, Co. Surv., until Jan. 13, for constructing the Dover ditches, requiring 33,260 cu. yds. of unclassified excavation at 15 cts. per cu. yd., the total cost to be about $4,989.

Panama.—Bids will be received by the Isthmian Canal Comn., Washington, D. C., until Jan. 2 for gantry crane and iron roof, as advertised in **The Engineering Record.**

Philadelphia, Pa.—The following are the bids opened on Dec. 16 by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for dredging and filling in at the navy yard, League Island, Pa. (price given per cu. yd.): Chas. Vivian & Co., Islip, L. I., 24.85 cts.; Henry Steers, 17 Battery Pl., New York, N. Y., 22⅖ cts., and Bowers Hydraulic Dredging Co., 104 Market St., Camden, N. J., 44½ cts.

Tacoma, Wash.—At the weekly meeting of the Bd. of Trus. of the Chamber of Commerce on Dec. 11, a special committee reported that the owners whose property abuts the Puyallup waterway have decided to bulkhead their lands. It is upon this condition that the U. S. Government will expend $240,000 in improving this waterway by dredging.

Hamilton, Ont.—Bids will be received until Feb. 5 by the Dept. Pub. Wks. (Fred Gelinas, Secy.), Ottawa, for constructing a wharf. J. G. Sing, Esq., Engr., **Confederation Life Bldg., Toronto.**

Guantanamo, Cuba.—Bids will be received until Jan. 20 by Mordecai T. Endicott, Ch. Bureau Yards and Docks, Navy Dept., Washington, D. C., for dredging at the Naval Station, Guantanamo. Funds available, $40,000.

PROPOSALS OPEN

For Proposals see pages 56. 58, 60, and 62.

WATER.

Bids Close.		See Eng. Record.
Dec. 26.	Pipe, etc., Washington, D. C.	Dec. 9
Dec. 27.	C. I. pipe, Brooklyn, N. Y.	Dec. 16
Dec. 27.	Well, Perth Amboy, N. J. Adv. Dec. 16, 23.	Dec. 16
Dec. 27.	Hydrants, New York, N. Y.	Dec. 16
Dec. 28.	Mains, New Brighton, S. I., N. Y.	Dec. 23
Dec. 29.	Boilers, Chicago, Ill.	Dec. 16
Dec. 29.	Canal, etc., Klamath Falls, Ore. Adv. Nov. 4 to Dec. 23.	Nov. 4
Dec. 30.	Pumping engine, Washington, D. C. Adv. Dec. 2 to Dec. 9.	Dec. 2
Dec. 30.	Tunnel, Chicago, Ill. Adv. Dec. 23.	Dec. 16
Dec. 30.	Mains, Seattle, Wash.	Dec. 23
Jan. 1.	Irrig. work, El Campo, Tex.	Oct. 7
Jan. 1.	Irrig. system, Encampment, Wyo.	Dec. 9
Jan. 1.	Pumping engine, Mitchell, S. D.	Dec. 23
Jan. 2.	**Water wks., Manila, P. I.**	**Sep. 30**
Jan. 2.	Water wks, Shenandoah, Va.	Dec. 2
Jan. 2.	Well, Rochelle, Ill. Adv. Dec. 16.	Dec. 16
Jan. 2.	Water wks., Piedmont, W. Va.	Dec. 16
Jan. 9.	Filter plant, power, etc., Macon, Miss. Adv. Dec. 16, 23.	Dec. 16
Jan. 9.	Plans for water wks. improv., Hobart, Okla. Adv. Dec. 23.	Dec. 23
Jan. 10.	Water wks., Osceola, Ark. Adv. Dec. 16, 23.	Dec. 16
Jan. 11.	Main, Ft. Lincoln, N. D.	Dec. 16
Jan. 15.	Irrig. canals, Huntley, Mont. Adv. Dec. 9 to 23.	Dec. 9
Jan. 15.	Pumping engine, Lincoln, Neb. Adv. Dec. 9 to 16.	Dec. 9
Jan. 15.	Irrigation work, Seattle, Wash.	Dec. 23
Jan. 15.	Cisterns, Key West Barracks, Fla.	Dec. 23
Jan. 15.	Water wks., Chihuahua, Mex. Adv. Dec. 23.	Dec. 16
Jan. 15.	Pumping engine, Albany, N. Y. Adv. Dec. 23.	Dec. 23
Jan. 15.	Water wks., Argenta, Ark.	Dec. 23
Feb. 1.	Water wks., Woodward, Okla. Ter.	Nov. 25
—	Pump, etc., Valdosta, Ga.	Dec. 2
—	Meters, Delphi, Ind.	Dec. 9

SEWERAGE AND SEWAGE DISPOSAL.

Dec. 26.	Philadelphia, Pa.	Dec. 16
Dec. 26.	Long Island City, L. I., N.Y.	Dec. 16
Dec. 26.	**Cincinnati, O.**	**Dec. 16**
Dec. 27.	Cincinnati. O.	Dec. 9
Dec. 28.	New York, N. Y.	Dec. 23
Dec. 28.	South Charlestown, O.	Dec. 23
Dec. 29.	Swinburne Island, N. Y. H. Adv. Dec. 23.	Dec. 23
Dec. 30.	Waterbury, Conn.	Dec. 9
Dec. 30.	Ft. Assinniboine, Mont.	Dec. 9
Dec. 30.	Brooklyn, N. Y.	Dec. 23
Dec. —.	Rockport, Ind.	Nov. 11
Jan. 12.	**Manila, P. I.**	**Sep. 30**
Jan. 15.	Washington, D. C. Adv. Dec. 16, 23.	Dec. 16
Jan. 15.	Texarkana, Ark.	Dec. 23
Jan. 15.	Chihuahua, Mex. Adv. Dec. 23.	Dec. 16
Feb. 1.	Woodlawn. Ala.	Oct. 28
Feb. 1.	Libertyville, Ill.	Nov. 25
Feb. 1.	St. Johns, Ore.	Dec. 16
Jan. 4.	Washington, Ia.	Dec. 16
Jan. 9.	Cincinnati, O.	Dec. 16
Feb. 15.	Princeton, Ind.	Nov. 25
Feb. 18.	Ravenna, O.	Dec. 16
Feb. —.	Lake Forest, Ill.	Nov. 25
Feb. —.	Highland Park, Ill.	Nov. 25

BRIDGES.

Dec. 27.	Norristown, Pa.	Dec. 2
Dec. 28.	Richmond, Ind.	Dec. 16
Dec. 28.	Redfield, S. D.	Dec. 16
Dec. 29.	Kilbourn, Wis.	Dec. 16
Jan. 1.	Pensacola, Fla.	Sep. 30
Jan. 2.	Helena, Mont.	Dec. 9
Jan. 2.	Zim, Minn.	Dec. 9
Jan. 2.	Lyndon, Kan.	Dec. 23
Jan. 3.	Cheyenne, Okla.	Dec. 16
Jan. 3.	Blue Earth, Minn.	Dec. 23
Jan. 3.	Oberlin, Kan.	Dec. 23
Jan. 4.	Salem, Mass.	Dec. 9
Jan. 4.	Gloucester, Mass.	Dec. 9
Jan. 5.	Vermillion, S. D.	Dec. 16
Jan. 6.	Manitowoc, Wis.	Dec. 16
Jan. 8.	Akron, O.	Dec. 23
Jan. 9.	Chattanooga, Tenn. Adv. Dec. 9, 16.	Dec. 9
Jan. 9.	Brookings, S. D.	Dec. 16
Jan. 10.	Huron, S. D.	Dec. 23
Jan. 15.	Pembina, N. D.	Dec. 23
Apr. 1.	West Fork, W. Va.	Dec. 2

PAVING AND ROADMAKING.

Dec. 26.	Toledo, O.	Dec. 23
Dec. 27.	Montgomery, Ala.	Dec. 9
Dec. 27.	Rochester, Ind.	Dec. 16
Dec. 27.	Brooklyn, N. Y.	Dec. 16
Dec. 27.	Cincinnati, O.	Dec. 23
Dec. 27.	San Francisco, Cal.	Dec 23
Dec. 28.	Little Rock, Ark.	Dec. 9
Dec. 28.	Wichita, Kan.	Dec. 16
Dec. 28.	Buffalo, N. Y.	Dec. 16
Dec. 28.	North Braddock, Pa.	Dec. 23
Dec. 28.	New Brighton, Pa. Adv. Dec. 23.	Dec. 23
Dec. 30.	Seattle, Wash.	Dec. 23
Jan. 2.	Helena, Mont.	Dec. 9
Jan. 2.	Brookville, Ind.	Dec. 16
Jan. 10.	Cleveland, O.	Dec. 23
Jan. 10.	Independence, Mo.	Dec. 23
Jan. 22.	Jacksonville, Fla.	Dec. 23
Jan. —.	Spencer, Ind.	Dec. 16
—	Lynchburg, Va. Adv. Dec. 16.	Dec. 16

POWER PLANTS, GAS AND ELECTRICITY.

Dec. 26.	Washington, D. C.	Dec. 2
Dec. 26.	Washington, D. C.	Dec. 16
Dec. 28.	Rio Vista, Cal.	Dec. 9
Dec. 28.	New York, N. Y.	Dec. 23
Dec. 30.	Vancouver Barracks, Wash.	Dec. 16
Dec. 30.	Rome, N. Y. Adv. Dec. 16, 23.	Dec. 16
Jan. 1.	Dothan, Ala.	Dec. 23
Jan. 2.	Shenandoah, Va.	Dec. 2
Jan. 2.	Tallapoosa, Ga.	Dec. 16
Jan. 2.	Washington, D. C.	Dec. 23
Jan. 2.	Brooklyn, N. Y.	Dec. 23
Jan. 4.	Jacksonville, Fla.	Dec. 16
Jan. 4.	Elbow Lake, Minn.	Dec. 16
Jan. 5.	Washington, D. C. Adv. Dec. 2 to 23.	Dec. 2
Jan. 9.	Washington, D. C.	Dec. 16
Jan. 9.	Anaheim, Cal.	Dec. 16
Jan. 15.	Cincinnati. O.	Dec. 2
Jan. 15.	Seattle, Wash.	Dec. 23
Jan. 15.	Argenta, Ark.	Dec. 23
Jan. 16.	Newark, N. J.	Dec. 16
Jan. 17.	Lock dam, etc., Lockport, Ill.	Dec. 23
—	Bamberg, S. C.	Dec. 2
Apr. 1.	Eugenia, Ont.	Dec. 16
Apr. —.	Oakesdale, Wash.	Nov. 25

BUILDINGS.

Dec. 26.	Hospital, Ft. Wood, N. Y. Harbor	Dec. 9
Dec. 26.	School, Toledo, O.	Dec. 16
Dec. 26.	Jail, Jacksonville, Fla.	Dec. 16
Dec. 26.	School, Binghamton, N. Y.	Dec. 16
Dec. 26.	Post bldg., Ft. Slocum, N. Y.	Dec. 16
Dec. 26.	Schools, New York, N. Y.	Dec. 16
Dec. 26.	Fire hall, Chattanooga, Tenn.	Dec. 23
Dec. 27.	Pub. bldg., New York, N. Y.	Dec. 23
Dec. 27.	Pub. bldg., Chicago, Ill.	Dec. 23
Dec. 27.	Fire hdqrs., Kansas City, Mo.	Dec. 23
Dec. 28.	Courthouse plans, Griffin, Ga.	Dec. 9
Dec. 28.	**Htg. P. O., Battle Creek, Mich.** Adv. Dec. 9 to 16.	**Dec. 9**
Dec. 28.	Court house improv., Greensburg, Pa.	Dec. 23
Dec. 28.	School, Quincy, Mass.	Dec. 23
Dec. 29.	School. Marquette, Mich.	Nov. 18
Dec. 29.	School, Pittsburg, Pa.	Dec. 16
Dec. 30.	Pub. bldgs., Ft. Assinniboine, Mont.	Dec. 9
Dec. 30.	Post bldgs., Angel Island, Cal.	Dec. 16
Dec. —	School, Bloomington, Ind.	Oct. 21
Jan. 1.	Hotel, Davenport, Ia.	Sep. 30
Jan. 1.	Jail, etc., Lillington, N. C.	Nov. 25
Jan. 1.	Repairing court house, etc., Kentland, Ind.	Dec. 9
Jan. 1.	School, Red Bluff, Cal.	Dec. 16
Jan. 1.	**Bus. bldg., Goldsboro, N. C.**	**Dec. 16**
Jan. 1.	Bus. bldg., Toledo, O.	Dec. 23
Jan. 1.	Jail plans, Vicksburg, Miss.	Dec. 23
Jan. 2.	School, Riverside, Cal.	Dec. 2
Jan. 2.	Pub. bldg., Akron, O.	Dec. 9
Jan. 2.	Htg., etc., school, New York, N. Y.	Dec. 23
Jan. 2.	Pub. bldg., Paris, Tex.	Dec. 23
Jan. 2.	Court house addition, Tampa, Fla.	Dec. 23
Jan. 4.	Post Office, Natchitoches, La.	Nov. 18
Jan. 4.	Library for Univ., Bloomington, Ind. Adv. Nov. 25.	Nov. 25
Jan. 4.	School, Pawhuska, Okla. Ter.	**Dec. 2**
Jan. 4.	Pub. bldg., Macon, Ga.	Dec. 23
Jan. 5.	Htg. pub. bldg., Washington, D. C. Adv. Dec. 2 to 23.	Dec. 2
Jan. 5.	School, Los Angeles, Cal.	Dec. 16
Jan. 5.	Htg. post office, Laramie, Wyo.	Dec. 16
Jan. 8.	Court house, Hillsboro, N. D.	Nov. 25
Jan. 8.	Improv. at War College, Washington, D. C. Adv. Dec. 9 to 23.	Dec. 9
Jan. 8.	Court house plans, Jasper, Ala.	Dec. 23
Jan. 8.	School plans, Neenah, Wis.	Dec. 23
Jan. 8.	School, Gainesville, Fla.	Dec. 23
Jan. 9.	Hospital, Cincinnati, O.	Dec. 16
Jan. 10.	**Library plans, Toronto, Ont.**	**Sep. 23**
Jan. 10.	P. O. bldg., Reno, Nev. Adv. Nov. 18 to 25.	Nov. 18
Jan. 11.	Post bldg., Ft. Du Pont, Del. Adv. Dec. 16, 23.	Dec. 16
Jan. 15.	School plans, Newark, N. J.	Dec. 9
Jan. 15.	School plans, Dallas, Tex.	Dec. 9
Jan. 15.	School, South McAlester, Ind. Ter.	Dec. 16
Jan. 15.	School, Lockland, O.	Dec. 16
Jan. 15.	School plans, Augusta, Ga.	Dec. 23
Jan. 17.	Stone work for pub. bldg., Washington, D. C. Adv. Dec. 23.	Dec. 23
Jan. 20.	Pub. bldg., Bremerton, Wash.	Dec. 16
Jan. 31.	Remov. courthouse, etc., Newark, N. J. Adv. Dec. 16, 23.	Dec. 16
Jan. —	**Hotel annex, Louisville, Ky.**	**Nov. 4**
Jan. —.	Htg. college, Medford, Mass.	Dec. 2
Jan. —.	Jail, Woodstock, Va.	Dec. 23
Feb. 1.	Plans for armory. Hartford. Conn.	Nov. 18
Feb. 1.	College, Dallas, Tex.	Dec. 16
Feb. 1.	School, Elm Grove, W. Va.	Dec. 23
Feb. —.	Hospital, Indianapolis, Ind.	Nov. 25
Feb. —.	Church, Lancaster, Pa.	Dec. 16
Mar. —.	Church, Wellston, O.	Dec. 16
Apr. —.	Hospital, Washington, D. C.	Dec. 23

MISCELLANEOUS.

Dec. 26.	Supplies, Washington, D. C.	Dec. 2
Dec. 26.	Supplies, Washington, D. C.	Dec. 9
Dec. 26.	Pine, etc., Guantanamo, Cuba	Dec. 9
Dec. 26.	Supplies, Washington, D. C.	Dec. 16
Dec. 26.	Levee, New Orleans, La.	Dec. 16
Dec. 26.	R. R. ties, Richmond, Va.	Dec. 16
Dec. 27.	Excav., Brooklyn, N. Y.	Dec. 16
Dec. 28.	Ditches, Lebanon, Ind.	Dec. 16
Dec. 29.	Wharf, Ft. Monroe, Va. Adv. Dec. 9 and 23.	Dec. 9
Dec. 20.	Fire alarm cable, Brooklyn, N. Y.	Dec. 23
Jan. 1.	Statue plans, Indianapolis, Ind.	Jul. 22
Jan. 1.	R. R. work, Dubuque, Ia.	Nov. 11
Jan. 1.	R. R. work, Cincinnati, O. Adv. Dec. 23.	Dec. 23
Jan. 2.	R. R. work, Santiago, Chili	Nov. 25
Jan. 2.	Supplies, Washington, D. C.	Dec. 23
Jan. 2.	El. ry. franchise, Bristol, Va.	Dec. 23
Jan. 2.	Crane, Panama. Adv. Dec. 23.	Dec. 23
Jan. 3.	El. Ry., San Francisco, Cal.	Dec. 16
Jan. 3.	Ditch, Iowa City, Ia.	Dec. 23
Jan. 4.	Garbage plant, Lexington, Ky. Adv. Dec. 9 to 23.	Dec. 9
Jan. 4.	Elevator, Ft. Worth, Tex.	Dec. 16
Jan. 5.	Elevators, Washington, D. C. Adv. Dec. 9 to 23.	Dec. 9
Jan. 6.	Caisson, Charleston, S. C.	Dec. 16
Jan. 6.	Levee work, New Orleans, La.	Dec. 23
Jan. 8.	Dredging, Jacksonville, Fla. Adv. Dec. 9 to 23.	Dec. 9
Jan. 8.	Garb. crematory, Ft. Barrancas, Fla.	Dec. 16
Jan. 9.	Wharf, etc., Auckland, N. Z. Adv. Oct. 14 to Dec. 9.	Oct. 14
Jan. 9.	**Jetty work, etc., Auckland, N. Z.** Adv. Nov. 4 to Dec. 9.	**Nov. 4**
Jan. 9.	Supplies, Washington, D. C.	Dec. 16
Jan. 12.	Ditch, Glencoe, Minn.	Dec. 9
Jan. 13.	Ditches, Cleveland, O.	Dec. 23
Jan. 15.	Excav. work, Buffalo, N. Y. Adv. Dec. 2, 16.	Dec. 2
Jan. 15.	Scow, Wilmington, N. C. Adv. Dec. 23.	Dec. 23
Jan. 20.	Dredging, Guantanamo, Cuba	Dec. 23
Feb. 5.	Wharf, Hamilton, Ont.	Dec. 23
Apr. 2.	**'06. Harbor Work, Valparaiso, Chili.** **Adv. Apr. 29 to Sep. 9.**	**Apr. 29**
Apr. 5.	Steel wharves, Manila, P. I.	Dec. 16
—	Filling in land, Far Rockaway, L. I., N. Y.	Dec. 16
—	R. R. work, Roanoke, Va. Adv. Dec. 16.	Dec. 16

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* *Items marked thus give the names of parties awarded contracts.*